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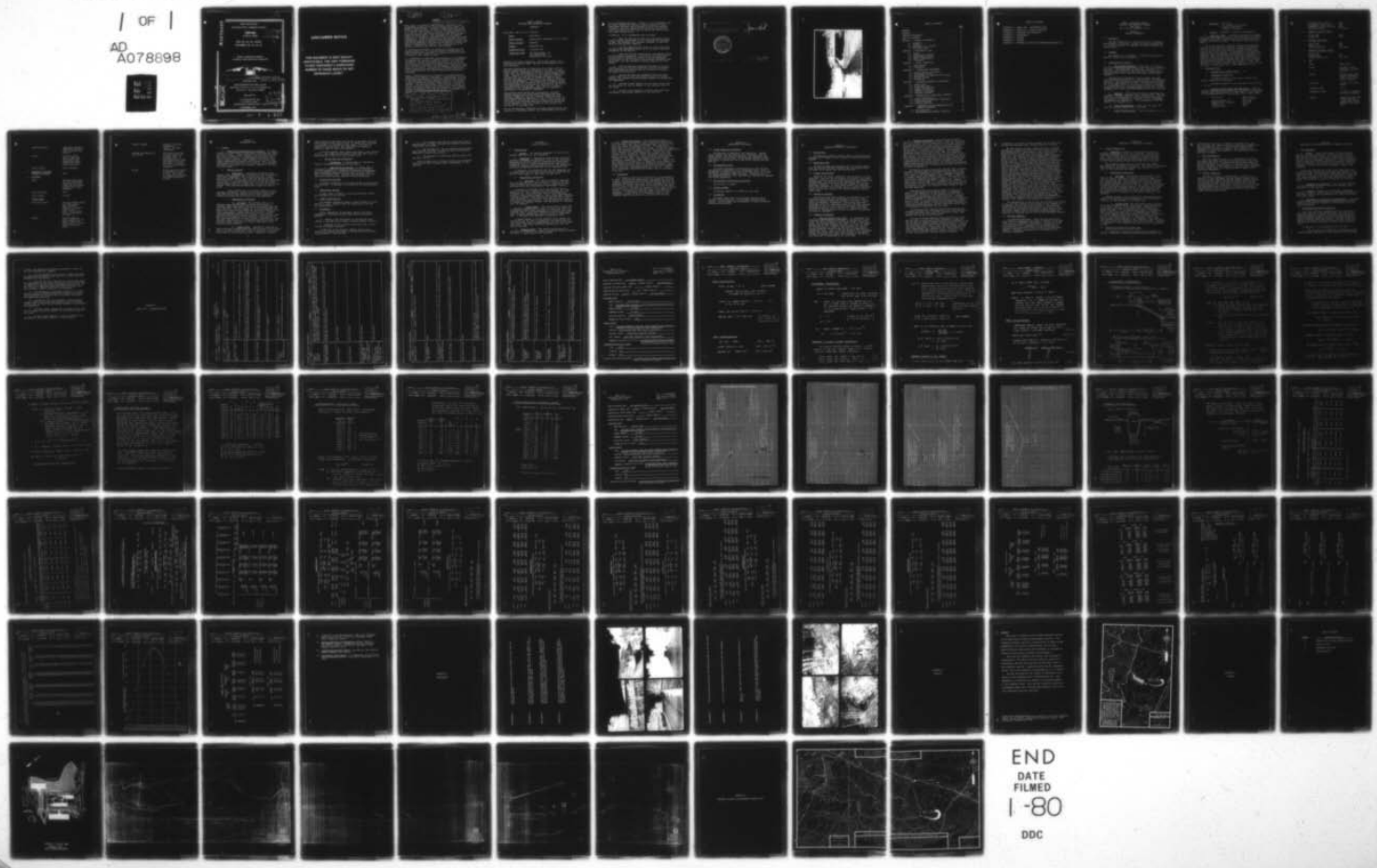

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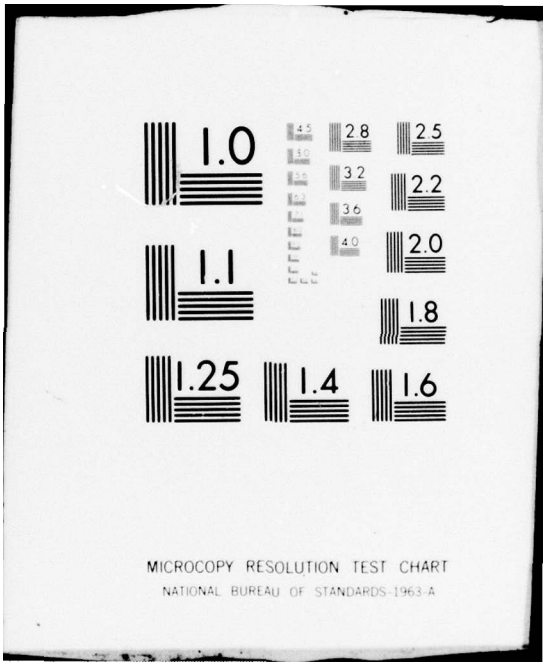
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OHIO RIVER BASIN

BEAVERDAM RUN, SOMERSET COUNTY

PENNSYLVANIA

GALLO DAM

NDS I.D. No. PA - 00233

PENNDER I.D. No. 56 - 91

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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Contract No. DACW31-79-C-0013

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
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SEPTEMBER 1979

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PREFACE

(15) DACW31-79-C-0013

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to humam life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

(6) National Dam Inspection Program. Gallo Dam (NDS I.D. Number PA-00233, Pennder I.D. Number 56-91) Ohio River Basin, Beaverdam Run, Somerset County, Pennsylvania. Phase I Inspection Report.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Gallo Dam: NDI I.D. No. PA-00233

Owner:	John Gallo
State Located:	Pennsylvania (PennDER I.D. No. 56-91)
County Located:	Somerset
Stream:	Beaverdam Run
Inspection Date:	6 August 1979
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, PA 15146

Based on the visual inspection, operational history, and available engineering data, the dam is considered to be in fair condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for this facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate that the facility is capable of passing and/or storing only about 13 percent of the PMF prior to overtopping of the embankment. Overtopping and embankment failure is anticipated under floods of less than 1/2 PMF magnitude and would result in an increase in the potential for loss of life downstream from the dam. Thus, based on criteria contained in the recommended guidelines, the spillway is considered to be seriously inadequate.

Deficiencies noted during the investigation include a densely overgrown and brush-strewn downstream dam face; erosion ditches cut into the irregular downstream face; saturated embankment conditions in the vicinity of the low level outlet from the dam toe to a point 13 feet below the dam crest; poor drainage conditions immediately downstream of the embankment toe; and rotation of the concrete cap portion of the spillway weir.

Due to the seriously inadequate spillway classification, the facility is considered unsafe, but non-emergency as failure

is not considered imminent. However, it is recommended that the owner immediately develop a warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

In addition, it is recommended that the owner:

a. Have the facility studied by a registered professional engineer experienced in the hydraulics and hydrology of dams, and implement the measures necessary to make the facility hydraulically adequate.

b. Cut the overgrowth and clear all brush from along the downstream embankment slope and toe to permit detailed inspection of the facility.

c. Have the facility inspected by a registered professional engineer experienced in the design and construction of earth dams to assess the stability of the embankment, particularly in the vicinity of the observed saturation near the siphon, and take necessary remedial measures as recommended.

d. Provide positive controlled drainage of the flow observed along the abutment-embankment contact and immediately downstream of the toe area to eliminate the ponding and swamp-like conditions.

e. Regrade and seed the embankment crest and downstream slope to eliminate concentrated runoff and erosion ditches, and provide a smooth surface amenable to maintenance and inspection.

f. Provide a means whereby the low level outlet pipe can be closed, as well as opened, on its upstream side, at all times.

g. Develop formal manuals to ensure continued care, maintenance, and proper operation of the facility.

GAI Consultants, Inc.

Bernard M. Mihalcin

Bernard M. Mihalcin, P. E.

Date 18 Sept 1979

Approved by:

James W Lech

Date 25 Sep 79

OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
GALLO DAM
NDI # PA-233, PENNDER # 56-91

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Gallo Dam is a 29-foot high earth embankment approximately 690 feet long (including spillway). The embankment is reportedly comprised of 3 sections which include an impervious core, a semi-pervious upstream section and a pervious downstream section. ~~(see Figure 3).~~

The facility is served by a chute channel spillway, with discharges controlled by a free overfall, concrete weir structure. The spillway is located near the right abutment, and has a crest length of 39 feet. In addition, the facility is equipped with a 18-inch diameter steel pipe encased in concrete used as a low level outlet as well as a 16-inch diameter steel siphon ~~(see Photograph 2)~~ which was installed in 1973.

b. Location. Gallo Dam is located on Beaverdam Run in Jenner Township, Somerset County, Pennsylvania. The dam, reservoir, and watershed are contained within the Boswell and Ligonier, Pennsylvania 7.5 minute U.S.G.S. topographic quadrangles (See Appendix G). The coordinates of the dam are N40° 8.8' and W79° 5.8'.

c. Size Classification. Small (29 feet high, 440 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (See Section 3.1.e.).

e. Ownership. John Gallo
c/o Ligonier Valley Beach
Lincoln Highway East
Ligonier, PA 15658 .

f. Purpose. Recreation (Commercial development).

g. Historical Data. Information available in PennDER files indicates that the facility was designed by the Neilan Engineers of Somerset, Pennsylvania and constructed by the Latrobe Construction Company. The facility was completed in 1958.

The field inspection indicated several discrepancies relative to the available drawings, including the orientation of the spillway, the relative freeboard between the original weir crest and the top of the dam, and the character of the outlet system. Correspondence in PennDER files indicates that, although the Neilan Engineers designed the facility, they did not provide construction inspection. In addition to the changes that were made during construction, several post-construction changes were made which included the raising the spillway crest and sidewalls in 1969, the addition of a 16-inch diameter steel siphon in 1973, and the placement of additional fill on the embankment in 1974.

1.3 Pertinent Data

a. Drainage Area (square miles). 3.8

b. Discharge at Dam Site.

Discharge Capacity of the Outlet Conduits-Discharge curves are not available.

Discharge Capacity of the Spillway at Maximum Pool ≈ 730 cfs.

c. Elevation (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements which were based on the elevation of the downstream toe of the spillway weir at 1843.5 feet.

Top of Dam	1853 (design) 1850.5 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	Not known
Normal Pool	1847.3
Spillway Crest	1847.3

Upstream Inlet Invert	1833
Downstream Outlet Invert	1822
Streambed at Dam Centerline	1822
Maximum Tailwater	Not known

d. Reservoir Length (feet).

Top of Dam	3100
Normal Pool	3000

e. Storage (acre-feet).

Top of Dam	440
Normal Pool	330
Design Surcharge	Not known

f. Reservoir Surface (acres).

Top of Dam	36
Normal Pool	33
Maximum Design Pool	Not known

g. Dam.

Type	Zoned Earth.
Length	690 feet (field measured; including spillway).
Height	29 feet (field measured; embankment crest to invert at outlet conduit).
Top Width	30 feet (field measured).
Upstream Slope	2H:1V
Downstream Slope	1-1/2H:1V (irregular and varies locally).
Zoning	Impervious core with a semi-pervious upstream shell and a pervious downstream shell.

	Impervious Core	Impervious material reportedly placed in thin lifts and compacted.
	Cutoff	A cutoff trench about 5 feet deep and 10 feet wide reportedly exists beneath the impervious clay core.
	Grout Curtain	None indicated.
h.	Diversion Canal and Regulating Tunnels.	None.
i.	Spillway.	
	Type	Concrete chute channel with discharges controlled by a concrete weir structure; located near right abutment.
	Crest Elevation	1847.3
	Crest Length	39 feet
j.	Outlet Works.	
	Low Level Outlet	18-inch diameter steel low level outlet pipe (blowoff) encased in concrete (See Figure 4. Note: Inlet riser was not constructed as shown).
	Siphon	16-inch diameter steel siphon; can be used to lower the water level to 6 feet below normal pool level.

Conduit Lengths	Blowoff - 108 feet (estimated) Siphon - 150 feet (estimated)
Closure and Regulating Facilities	Low level outlet has concrete plug (lid) on short riser on upstream side. A galvanized steel cable (attached to lid and dam crest) is pulled to lift plug and drain reservoir.
Access	Galvanized steel cable is attached to crest of dam. Gate valve on siphon is accessible from downstream face of dam.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports or calculations are available concerning any aspect of this facility. Design drawings were obtained from PennDER files, although field inspection notes indicate that they are not as-builts. Correspondence and permit application reports obtained within PennDER files contain few design references and details, and indicate that no formal construction specifications were prepared. Soil placement and compaction criteria were, however, amended to the construction permit.

b. Design Features.

1. Embankment. Information contained within PennDER files indicates that the structure was designed as a zoned earth embankment with an impervious core, a semi-pervious upstream shell, and a pervious downstream shell (See Figure 3). The upstream face was mantled with sandstone riprap from 4 feet below normal pool up to the dam crest. The downstream face was covered with 4 inches of topsoil and seeded. Both upstream and downstream slopes were set at 2H:1V.

Little information is available relative to the embankment foundation, except that a cutoff trench about 5 feet deep and 10 feet wide was to have been constructed beneath the impervious core section of the embankment.

2. Appurtenant Structures.

a) Spillway. The spillway was to be a concrete chute channel with discharges controlled by a concrete trapezoidal-shaped weir structure located near the right abutment. The weir crest was to be approximately 40 feet long, with the weir flanked by concrete wingwalls which were to rise about 8 feet above the weir crest. However, field measurements indicate that only about a 5.5-foot freeboard was provided for the spillway. Modifications were made to the spillway in 1969, resulting in the raising of the crest and sidewalls to their present configuration. The spillway sidewalls were not raised an equal height with the spillway crest, resulting in a further reduction of the design spillway capacity.

b) Outlet Works. Information contained on design drawings indicates that the facility was to be provided with a low level outlet and a vertical concrete riser which would serve as the primary spillway. Apparently, however,

these plans were modified, and the dam is provided only with the low level outlet conduit which is capped with a concrete lid attached to a galvanized steel cable. The cable is secured to the dam crest, and reportedly can simply be pulled in order to drain the reservoir.

A 16-inch diameter steel siphon was added to the facility in 1973. The siphon can be used to lower the water level to approximately 6 feet below the spillway crest.

c. Design Data and Procedures.

1. Embankment. No design data or information relative to design procedures are available.

2. Appurtenant Structures. No design data or information relative to design procedures are available, with the exception of a reference in PennDER correspondence which recommends designing the spillway to pass a flow of 900 cfs per square mile. Numerous discrepancies exist between the design drawings and the as-built conditions.

2.2 Construction Records.

No records pertaining to the construction of the facility are available. In addition, no records of the modifications exist.

2.3 Operational Records.

No pool level, rainfall or spillway discharge records are available for the facility

2.4 Other Investigations.

Two PennDER inspection reports, dated November 25, 1958 and May 2, 1963, indicate that the conditions at the dam were satisfactory.

2.5 Evaluation.

Little information is available relative to design parameters. Some modifications made during construction include:

1. Change in the inclination of the spillway with respect to the dam axis as shown on design drawing (Figure 2).

2. Deletion of the concrete riser which was to function as the primary spillway.

In addition to the as-built changes, several post-construction changes were made to the facility which affect its performance. They include:

1. The re-shaping and raising of the weir crest by approximately two feet, although the sidewalls were only raised about six inches.

2. The addition of a 16-inch diameter steel siphon which enables the owner to lower the pool level without completely draining the facility.

3. The placement of additional material along the dam crest in 1974.

The available data, although limited, are considered sufficient to make a general Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests that it is in fair condition.

b. Embankment. Observations made during the visual inspection indicate the embankment to be in fair condition. Deficiencies include a heavily overgrown and brush-strewn downstream face, an uneven downstream slope with erosion ditches at several locations (See Figure 1), and swamp-like conditions immediately downstream of the embankment toe.

In addition, the downstream face of the embankment is saturated above the low level outlet conduit, from the dam toe to a point about 13 feet below the dam crest.

c. Appurtenant Structures.

1. Spillway. The visual inspection indicated that the spillway is in fair condition. Much of the concrete surfaces exhibit scaling, and the wingwalls contain hairline cracks and efflorescence (See Photos 1 and 3).

A portion of the lower end of the spillway was dislodged in the past, necessitating some remedial work (See Photograph 4). Also, the weir crest was re-shaped and raised in 1969 by approximately 2 feet, while approximately 6 inches of concrete was added to the spillway weir sidewalls (See Photograph 3). The modification has resulted in the reduction of spillway capacity. The spillway crest addition is cracked and somewhat rotated (See Photograph 3), possibly from ice pressure.

2. Outlet Works. The outlet works at Gallo Dam is somewhat unconventional in that, to drain the reservoir, a galvanized steel cable connected to a concrete lid on the upstream side of an 18-inch diameter concrete-encased steel pipe is pulled, essentially pulling the plug on the reservoir. A new cable was reportedly installed in 1978.

A second outlet, a 16-inch diameter steel siphon, was functioning at the time of inspection, and can be used to lower the water level to approximately six feet below normal pool level. The siphon basically operates as a low flow service spillway.

d. Reservoir Area. The terrain surrounding the reservoir is moderately to steeply sloped and lightly forested. No signs of slope distress were observed.

e. Downstream Channel. The downstream channel is confined within a relatively gently sloped and broad floodplain for about 9000 feet to Beaverdam Runs' confluence with the North Branch of Quemahoning Creek. No dwellings or structures are located within this reach. In the next 4000 feet, the floodplain broadens and the North Branch of Quemahoning Creek combines with Quemahoning Creek. Several coal processing and/or related structures are located within this portion of the floodplain. These structures could suffer damage from the large flows which should be associated with a breach of Gallo Dam. Approximately 8000 feet further downstream, Quemahoning Creek passes under U. S. Route 30 in the community of Ferrellton. A commercial establishment and three mobile homes are situated sufficiently close to the stream such that large flows could cause significant damage to the dwellings (estimated population 10 to 20). Therefore, the hazard classification of Gallo Dam is considered to be high.

3.2 Evaluation.

The overall condition of the facility is considered to be fair. Deficiencies noted during the inspection included a dense overgrowth and brush-strewn downstream dam face; an irregular downstream face, with erosion ditches cut into the embankment at several locations; and a saturated zone above the low level outlet pipe, from 13 feet below the dam crest to the dam toe. The spillway appears to be in fair condition; however, modifications to the weir crest have reduced its capacity. A siphon pipe has been added to the facility, presumably to provide low flow discharge capacity, and drawdown capability without fully draining the facility.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The facility is basically self-regulating. Excess inflow passes over the concrete weir structure, into the chute channel, and finally discharges into Beaverdam Run. Discharge at low pool level can be passed through a siphon pipe which is controlled via a gate valve located near the dam toe.

4.2 Maintenance of Dam.

No formal maintenance program exists at the facility. Maintenance is performed on an unscheduled basis. Rock is stockpiled at several locations on the dam crest and is used for riprap replacement when necessary. Trees were cut on the downstream face in 1979, but were not removed and hindered the visual inspection.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

No warning system is in effect at this time.

4.5 Evaluation.

No formal operations or maintenance manuals are available for the facility, and no formal warning system exists. Formal manuals are recommended to ensure continued maintenance and safety.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic/hydraulic design data or calculations are available with respect to the original or modified spillway systems.

5.2 Experience Data.

No daily records are available; but, the owner reports that the maximum spillway discharge has been approximately 14 inches to 16 inches over the existing weir.

5.3 Visual Observations.

Based on the visual inspection, the spillway is in fair condition. The weir cap is cracked and slightly misaligned; however, failure of the cap would not produce any significant consequences. The failure of the downstream edge of the spillway (probably from undercutting) appears to have been adequately repaired. No major deficiencies were observed that would indicate the spillway could not perform satisfactorily, within the limits of its design capacity, during a flood event.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U.S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Gallo Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. The classification is based on the relative size (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for downstream damage, and to the relatively large storage volume behind the dam at maximum pool (about 440 acre-feet), the SDF for this facility is considered to be in the PMF.

b. Results of Analysis. Gallo Dam was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of approximately 1847.3 feet, with all low level outlets assumed to be closed, and the spillway discharging freely. The spillway is a concrete chute channel, with discharges controlled by a concrete weir structure. The necessary downstream channel routing was done under the assumption that the routing stream was dry prior to the inflow of the dam outflow. Only the potential storage available along the main watercourse was considered in the routing computations. A more detailed study might consider the potential storage capabilities of the various tributary streams, since the stream gradients are quite gentle. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Gallo Dam can accommodate only about 13 percent of the PMF (SDF) prior to the overtopping of the embankment (Appendix C, Summary Input/Output Sheets, Sheet J). The low top of the dam was inundated by depths of water of 1.7 and 3.1 feet under the 1/2 PMF and PMF events, respectively (Summary Input/Output Sheets, Sheet J). Therefore, since the SDF for this facility is the PMF, Gallo Dam has a high potential for overtopping, and thus, for breaching under floods of less than SDF magnitude.

Since Gallo Dam cannot safely handle a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of 1/2 PMF intensity or less was investigated (in accordance with ETL-1110-2-234). Several feasible alternatives were analyzed since it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. The major concern of the breaching evaluations is with the impact of the various breach discharges on increasing downstream water surface elevations above those to be expected if breaching did not occur.

The Modified HEC-1 Computer Program was used for the breaching analysis with the assumption that the breaching of an earth dam would begin once its reservoir's water level reached the low top of dam elevation.

Two sets of breach geometry were evaluated for Gallo Dam for each of two failure times (Appendix C, Sheet 18). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for each breach section to reach its final dimensions), under which the two breach sections were investigated, were assumed to be a rapid time (0.5 hours) and a prolonged time (4.0 hours), so that a range of this most sensitive variable might be examined.

In addition, an average or more probable set of breach conditions was analyzed, with a failure time of 2.0 hours.

The peak breach outflows (resulting from a 0.15 PMF overtopping) ranged from about 2540 cfs for the minimum section-maximum fail time scheme to about 20090 cfs for the maximum section-minimum fail time scheme (Appendix C, Sheet 20). The outflow from the average breach scheme was about 5720 cfs, compared to the non-breach 0.15 PMF peak outflow of about 860 cfs (Summary Input/Output Sheets, Sheets M and J). The water surface elevation corresponding to the non-breach 0.15 PMF peak discharge at the section (Section 6) located about 15600 feet downstream from the dam was approximately 1811.5 feet (MSL); and approximately 1802.1 feet (MSL) at a section (Section 8) located about 21050 feet downstream from the dam (Summary Input/Output Sheets, Sheet K). The water surface elevations corresponding to the average breach conditions peak outflows at the two above-mentioned downstream sections were 1815.7 feet (MSL) and 1807.7 feet (MSL), respectively (Summary Input/Output Sheets, Sheet P). The approximate elevation of the residence located at Section 6 is about 1820 feet (MSL); while the approximate elevation of the residences and businesses located at Section 8 is about 1806 feet (MSL). Therefore, the increase in the water surface at Section 6, caused by the failure of Gallo Dam, was about 4.2 feet, with the breach water surface well below the dam level of the residence. The increase in the water surface at Section 8, caused by the failure of the dam, was about 5.6 feet, with the breach water surface above the damage level of the structures. It can further be surmised that embankment failure under somewhat larger base flood conditions could possibly cause damage to the residence at Section 6.

The consequences of dam failure can be better envisioned if not only the increase in the height of the floodwave is considered, but also the great increase in the momentum of the larger and probably swifter moving volume of water. Therefore, the failure of Gallo Dam is quite possible, and will most probably lead to increased property damage and possibly to increased loss of life in the downstream regions.

5.6 Spillway Adequacy.

As presented previously, under existing conditions, Gallo Dam can accommodate only about 13 percent of the PMF (SDF) prior to embankment overtopping. Should a 0.15 PMF or larger event occur, the dam would be overtopped and could possibly fail, endangering the residences and increasing the potential for loss of life in the downstream regions. Therefore, the spillway is considered to be seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appeared to be in fair condition. Several deficiencies were noted which will require the owner's attention. They include removing vegetation, grading and backfilling erosion ditches on the downstream face of the dam, and providing adequate drainage along the toe of the dam.

Two saturated areas were also noted near the siphon pipe (above the low level outlet pipe). The zones of saturation and hydrophilic vegetation extended from the dam toe to a point 13 feet below the dam crest.

b. Appurtenant Structures.

1. Spillway. The spillway was modified in 1969 when two feet of concrete was added to the weir crest in order to provide additional reservoir depth and surface area for recreational use. This spillway cap has since cracked and rotated somewhat (see Photograph 3). Since the cap only represents the upper two feet of the weir crest, the situation is not considered critical; however, it should be noted that the weir was also reshaped and the spillway sidewalls were not raised accordingly when the crest was raised, both of which have led to a reduction in the actual capacity of the spillway.

Moderate scaling, minor cracking and efflorescence were noted on the spillway apron and sidewalls, but the overall condition of the spillway is considered fair.

2. Outlet Works. The low level outlet works at Gallo Dam consists of an 18-inch diameter steel pipe encased in concrete. The dam owner reports that a concrete lid covers the small riser on the upstream end of the pipe as shown on Figure 4. A galvanized steel cable is attached to the lid and to the dam crest by an embedded metal anchor. A 16-inch diameter steel pipe siphon was added to the facility in 1973 to afford the ability to lower the reservoir to about 6 feet below normal pool, if necessary. The siphon was operated in the presence of the inspection team, but the low level outlet has apparently never been utilized. According to the owner, a diver replaced the steel cable lid attachment in 1978.

6.2 Design and Construction Techniques.

No information is available concerning the details of design. Historical documents contained within PennDER files

indicate that the site is underlain by minable coal, and that measures were taken to preclude deep mining beneath the dam and reservoir area. No formal specifications were prepared for construction; however, soil placement and compaction criteria were amended to the construction permit by State reviewers.

6.3 Past Performance.

The owner reported that to his knowledge the facility has never overtopped, and that the maximum water level that he recalls was 14 to 16 inches above the spillway crest, or about 2 feet below the dam crest. A portion of the concrete spillway adjacent to the plunge pool was dislodged, apparently during a large storm, but remedial measures appear to be performing adequately

6.4 Seismic Stability.

The dam is located in Seismic Zone 1, and is thus subject to minor earthquake induced dynamic forces. Due to the lack of data concerning the engineering characteristics of the materials used to construct the dam, the possible high phreatic surface above the low level outlet, and the apparent dumped (and uncompacted) condition of the soil near the downstream side of the crest, it cannot be presently assumed that the facility could tolerate even minor earthquake induced dynamic forces.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. Visual observations indicate that the facility is in fair condition. Hydrologic and hydraulic calculations performed during this investigation indicate that the facility will pass and/or store only 13 percent of the PMF prior to embankment overtopping. Based on screening criteria supplied by the Department of the Army, Office of Chief of Engineers, the spillway is deemed to be seriously inadequate, and the facility is considered unsafe, non-emergency.

Structural deficiencies noted by the inspection team during the field investigation included some erosion of the downstream slope, and a saturated downstream dam face in the vicinity of the low level outlet pipe and siphon. Additionally, dense vegetation and cut trees strewn on the downstream face preclude an accurate evaluation of its condition.

b. Adequacy of Information. The available information is considered sufficient to make an adequate Phase I assessment of the facility.

c. Urgency. Because of the seriously inadequate spillway, a warning system should be implemented immediately. Additional studies, as recommended below, should be carried out without delay.

d. Necessity for Additional Investigations. Additional investigations to more accurately determine the structural stability and hydraulic adequacy of the facility are considered necessary.

7.2 Recommendations/Remedial Measures.

Due to the seriously inadequate spillway classification, the facility is considered unsafe. Failure is not considered imminent; however, the owner should immediately develop a warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

In addition, it is recommended that the owner:

a. Have the facility studied by a registered professional engineer experienced in the hydraulics and hydrology

of dams, and implement the measures necessary to make the facility hydraulically adequate.

b. Cut the overgrowth and clear all brush from along the downstream embankment slope and toe to permit detailed inspection of the facility.

c. Have the facility inspected by a registered engineer experienced in the design and construction of earth dams to assess the stability of the embankment, particularly in the vicinity of observed saturation near the siphon, and take necessary remedial measures as recommended.

d. Provide positive controlled drainage of the flow observed along the abutment-embankment contact and immediately downstream of the toe area to eliminate the ponding and swamp-like conditions.

e. Regrade and seed the embankment crest and downstream slope to eliminate concentrated runoff and erosion ditches, and provide a smooth surface amenable to maintenance and inspection.

f. Provide a means whereby the low level outlet pipe can be closed, as well as opened, on its upstream side, at all times.

g. Develop formal manuals to ensure continued care, maintenance, and proper operation of the facility.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Lake Gloria Dam

NDI#: PA-233 PENNDER# : 56-91

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA -
PERSONS INTERVIEWED AND TITLE	Mr. John E. Gallo - owner.
REGIONAL VICINITY MAP	See Appendix G. (U.S.G.S. 7.5 minute topographic quadrangles: Boswell and Ligonier, PA).
CONSTRUCTION HISTORY	Construction completed in 1958 by the Latrobe Construction Company. Original design by the Neilan Engineers. Data available in PennDER files.
AVAILABLE DRAWINGS	PennDER files contain Drawings and sections; however, field inspection indicates they are not as-built.
TYPICAL DAM SECTIONS	See Figure 3, Appendix F.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 4, Appendix F. Siphon (16-inch diameter steel pipe) added around 1973.

ITEM	REMARKS NDI# PA - 00233
SPILLWAY: PLAN SECTION DETAILS	Spillway weir modified in 1969 by reshaping and raising the crest by about two feet (a rectangular-shaped concrete cap was placed over the original trapezoidal-shaped weir). Spillway sidewalls raised only about 6 inches. See Figure 4 for original design.
OPERATING EQUIPMENT PLANS AND DETAILS	Galvanized steel cable used to lift concrete cap from small riser on upstream side of low level outlet.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None available.

ITEM	REMARKS NDI# PA - 00233
BORROW SOURCES	Not known. Probably from within reservoir.
POST CONSTRUCTION DAM SURVEYS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	PennDER inspection reports of 1958 and 1963, available in PennDER files.
HIGH POOL RECORDS	14 inches to 16 inches over spillway weir according to owner.
MONITORING SYSTEMS	None.
MODIFICATIONS	Siphon pipe added in 1973. Concrete added to sidewalls and concrete cap added to spillway weir in 1969. Material added to embankment crest in 1974.

NDI# PA 00233

ITEM	REMARKS
PRIOR ACCIDENTS OR FAILURES	Toe of spillway washed away during large storm. Remedial concrete placed to prevent further erosion.
MAINTENANCE: RECORDS MANUAL	No records or formal manual are available. Maintenance such as clearing slope, replacing riprap, patching spillway, etc., done on unscheduled basis by the owner.
OPERATION: RECORDS MANUAL	No records or formal manual are available.
OPERATIONAL PROCEDURES	Siphon left open at all times. Otherwise, self-regulating.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None.
MISCELLANEOUS	Owner resides in Ligonier, approximately 15 minutes from the dam. Facility opened to the public from Memorial Day through Labor Day.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00233
PENN DER ID # 56-91

SIZE OF DRAINAGE AREA: 3.8 square miles

ELEVATION TOP NORMAL POOL: 1847.3 STORAGE CAPACITY: 330 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 1850.5 STORAGE CAPACITY: 440 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1847.3 feet

TYPE: Concrete chute channel, with discharges controlled by a concrete weir structure.

CREST LENGTH: 39 feet

CHANNEL LENGTH: 60 feet

SPILLOVER LOCATION: right abutment

NUMBER AND TYPE OF GATES: none

OUTLET WORKS

TYPE: 18-inch diameter steel low level blowoff pipe encased in concrete; 16-inch diameter steel siphon pipe.

LOCATION: both located near left side of spillway.

ENTRANCE INVERTS: 1833 feet (blowoff; design)

EXIT INVERTS: 1822 feet (blowoff; field measurement)

EMERGENCY DRAWDOWN FACILITIES: Galvanized steel cable connected to embankment crest and to concrete lid covering blowoff inlet.

HYDROMETEOROLOGICAL GAGES

TYPE: None

LOCATION: N/A

RECORDS: N/A

MAXIMUM NON-DAMAGING DISCHARGE: 14 inches to 16 inches over spillway weir crest (according to owner).

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

BY DTS DATE 9-8-79 PROJ. NO. 78-617-233

CHKD. BY WJV DATE 9-9-79 SHEET NO. 1 OF 21

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DAM STATISTICS

HEIGHT OF DAM ≈ 29 FT (FIELD MEASURED)

(MEASURED FROM LOW TOP OF DAM EL. 1853.5 FT
TO INVERT OF BLOWOFF EL 1822.0 FT)

MAXIMUM POOL STORAGE CAPACITY ≈ 440 AC-FT (HEC-1)
AT LOW TOP OF DAM

NORMAL POOL STORAGE CAPACITY ≈ 330 AC-FT (HEC-1)

DRAINAGE AREA ≈ 3.8 SQUARE MILES [PLANIMETERED OFF USGS 7.5 MINUTE QUADS: LIGONIER AND DONEGAL, PA]

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - ½ PMF TO PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 4.0 MILES

L_{CA} ≈ 2.0 MILES (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM CREST TO BASIN CENTROID)

NOTE 1: VALUES OF L AND L_{CA} WERE MEASURED FROM THE USGS 7.5 MINUTE QUADS OF LIGONIER AND DAWELL, PA. ALL HYDROGRAPH VARIABLES ARE DEFINED IN REFERENCE 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

C_t ≈ 1.6

C_p ≈ 0.45

[SUPPLIED BY C.O.E., ZONE 24, OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG ≈ $1.6\,(L \times L_{CA})^{0.3}$

$t_p \approx 1.6\,(4.0 \times 2.0)^{0.3} \approx 2.99$ HOURS

RESERVOIR ELEVATION - STORAGE RELATIONSHIP

THE RESERVOIR ELEVATION-STORAGE RELATIONSHIP IS COMPUTED INTERNALLY BY THE HEC-1 PROGRAM, BASED ON THE FOLLOWING ELEVATION - SURFACE AREA - STORAGE INFORMATION:

DESIGN NORMAL POOL STORAGE ≈ 260 ACRE-FT
DESIGN NORMAL POOL ELEVATION ≈ 1845.0 FT
DESIGN NORMAL POOL SURFACE AREA (S.A.) ≈ 30.2 ACRES

[SEE NOTE 2]

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

BY DTS DATE 9-8-79 PROJ. NO. 78-617-233

CHKD. BY WJV DATE 9-9-79 SHEET NO. 3 OF 21

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NOTE 2: DESIGN NORMAL POOL SURFACE AREA AUD STORAGE VALUES OBTAINED FROM " REPORT UPON THE APPLICATION OF COND GALLO (FOR THE CONSTRUCTION OF A DAM ACROSS BEAVERDAM RUN, IN JENNER TOWNSHIP, SOMERSET COUNTY ", AS FOUND IN PENNDER FILES. THE ACTUAL REPORTED STORAGE VALUE WAS 85.9 MILLION GALLONS. DESIGN NORMAL POOL ELEVATION OBTAINED FROM APPENDIX F, FIG 4.

SA @ EL. 1860 ≈ 47 ACRES
SA @ EL. 1880 ≈ 86 ACRES

[PLANIMETERED OFF USGS 7.5 MINUTE QUADS: LIGONIER, ISWELL, PA]

NORMAL POOL ELEVATION ≈ 1847.3 FT (FIELD MEASURED)
LOW TOP OF DAM ELEVATION ≈ 1850.5 FT

RATE OF SA INCREASE PER FOOT OF RESERVOIR ELEVATION RISE:

$$\Delta SA/\Delta H = \frac{(47-30)}{(1860-1845)} = 1.1 \text{ AC/FT}$$

$$\therefore SA @ 1847.3 \approx 30 + (1.1)(1847.3-1845) \approx 33 \text{ ACRES}$$

$$SA @ 1850.5 \approx 30 + (1.1)(1850.5-1845) \approx 36 \text{ ACRES}$$

RESERVOIR ELEVATION AT "0" STORAGE:

STORAGE @ DESIGN NORMAL POOL ELEV ≈ $\frac{1}{3}HA$ ≈ 260 AC-FT (CONIC METHOD)

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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SA @ DESIGN NORMAL POOL = 30 ACRES

$\therefore H \approx (3)(260)/(30) \simeq 26$ FT

ZERO VOLUME ELEVATION ≈ 1845 - 26 = 1819 FT

NOTE 3: IN ORDER TO COMPUTE AN ELEVATION-STORAGE RELATIONSHIP, WITH A STORAGE OF 260 ACRE-FT AT ELEVATION 1845, THE ABOVE COMPUTED "0" - STORAGE ELEVATION MUST BE INPUT INTO THE HEC-1 PROGRAM. THE ACTUAL DESIGN MINIMUM RESERVOIR ELEVATION IS ON THE ORDER OF 1829 FT (FIG 4); HOWEVER, IT IS FELT THAT THIS ELEVATION COULD BE IN ERROR.

PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 INCHES, CORRESPONDING TO A DURATION OF 24 HRS AND AN AREA OF 200 SQ. MILES, LOCATED IN SOUTH CENTRAL PENNSYLVANIA. (REF 3, FIG 1)

- DEPTH-AREA-DURATION ZONE # 7 (REF 3, FIG 1)

- DRAINAGE AREA ≈ 3.8 SQ. MI.; ASSUME DATA CORRESPONDING TO A 10-SQ. MI. AREA IS REPRESENTATIVE OF THIS BASIN:

DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	102
12	130
24	130
48	140

(REF 3, FIG 2)

- HOP BROOK ADJUSTMENT FACTOR FOR A = 4 SQ MI: 0.80 (HEC-1)

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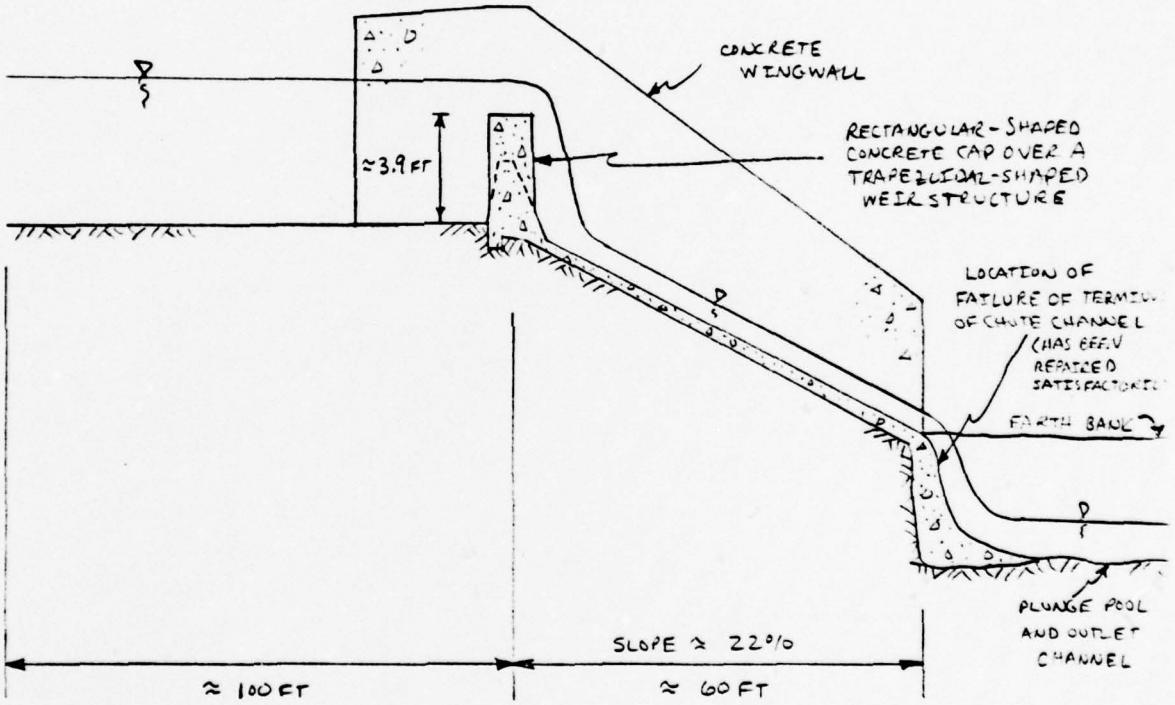
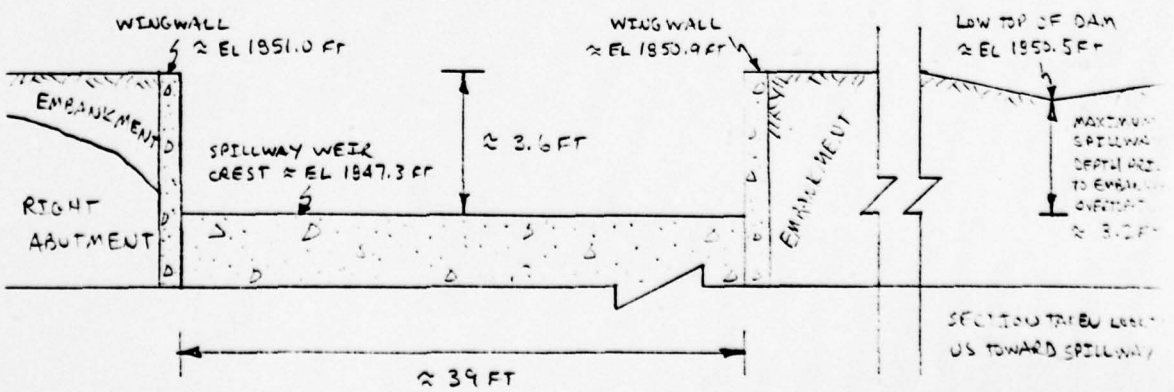
SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND APPENDIX F)



- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
(OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND APPENDIX F)



SUBJECT DAM SAFETY INSPECTION
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- THE SPILLWAY IS A CONCRETE CHUTE CHANNEL, WITH DISCHARGES CONTROLLED BY A CONCRETE WEIR STRUCTURE. THE PRESENT WEIR IS RECTANGULAR IN CROSS-SECTION, AND IS THE RESULT OF CAPPING A TRAPEZOIDAL-SHAPED WEIR SECTION. FLOW OVER THE WEIR CAN BE DEFINED BY :

$$Q = C L H^{3/2} \qquad \text{(REF 5, PG 5-3)}$$

WHERE Q = DISCHARGE OVER WEIR, IN CFS;
L = LENGTH OF WEIR CREST ≈ 39 FT (FIELD MEASURED);
H = HEIGHT OF RESERVOIR ABOVE SPILLWAY CREST EL 1847.3 FT, ASSUMED DESIGN HEAD (H_o) ≈ 3.2 FT;
C = DISCHARGE COEFFICIENT ≈ 3.33 @ ASSUMED DESIGN HEAD

NOTE 4 : THE WEIR HAS A FLAT CREST WHOSE BREADTH IS ABOUT 1 FT, AND THE US AND DS SIDESLOPES ARE VERTICAL. THEREFORE, ALTHOUGH THE WEIR IS NOT ACTUALLY SHARP-CRESTED, IT IS ASSUMED THAT THE REPRESENTATIVE WEIR COEFFICIENT AT THE DESIGN HEAD IS ON THE ORDER OF 3.33 (CORRESPONDING TO A SHARP-CRESTED WEIR; REF 5, PG 5-7).

- APPROACH CHANNEL LOSSES @ DESIGN FLOW :

a) APPROXIMATE APPROACH CHANNEL LENGTH = 100 FT
AVERAGE APPROACH CHANNEL WIDTH ≈ 50 FT
} INFERRED FROM APPENDIX E FIG 2

LEFT SIDE OF APPROACH CHANNEL CONSISTS OF THE LEFT SPILLWAY WINGWALL WHICH VARIES FROM ABOUT 7.6 FT ABOVE THE CHANNEL AT THE WEIR TO ABOUT 6.6 FT ABOVE THE

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CHANNEL AT THE CHANNEL ENTRANCE. THE WINGWALL IS VERTICAL. (INFORMATION FROM FIG 4, AND FIELD MEASUREMENTS)

RIGHT SIDE OF APPROACH CHANNEL CONSISTS OF THE VEGETATED RIGHT ABUTMENT WHICH HAS AN ESTIMATED 2H TO 1V SIDESLOPE FOR ALL APPROACH CHANNEL DEPTHS. (INFORMATION FROM FIELD OBSERVATION)

∴ @ RESERVOIR EL 1850.5FT (LOW TOP OF DAM) THE MAXIMUM APPROACH CHANNEL DEPTH = FOREBAY DEPTH + HEAD OVER WEIR ≈ 3.9 FT + 3.2 FT ≈ 7.1 FT

⇒ AVERAGE APPROACH CHANNEL FLOW AREA = A_a

$$A_a \approx (50\text{FT} \times 7.1\text{FT}) + [\tfrac{1}{2}(2 \times 7.1\text{FT})(7.1\text{FT})]$$
$$\approx 405\ \text{FT}^2$$

b) INITIAL ESTIMATE OF DISCHARGE @ EL 1850.5 FT :

$$Q \approx (3.33)(39\text{FT})(3.2\text{FT})^{3/2} \approx 740\ \text{CFS}$$

c) AVERAGE APPROACH CHANNEL VELOCITY ≈ Q/A_a

$$v_a \approx 740\ \text{CFS}/405\ \text{FT}^2 \approx 1.8\ \text{FPS}$$

⇒ AVERAGE APPROACH VELOCITY HEAD = $h_a \approx v_a^2/2g$

$$h_a \approx (1.8\ \text{FPS})^2/2g \approx 0.05\ \text{FT}$$

ASSUMING THAT THE APPROACH CHANNEL ENTRANCE LOSS ≈ 0.1 h_a (REF 4, PG 379) ⇒ 0.01 FT

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d) APPROACH CHANNEL FRICTION LOSS = $h_f \approx \left[V_a n / 1.49 R_n^{2/3} \right]^2 \times L_c$

WHERE L_c = LENGTH OF APPROACH CHANNEL ≈ 100 FT (SEE SHEET 6);

n = MANNINGS ROUGHNESS COEFFICIENT ≈ 0.05 (REF 7, PG 112; EXCAVATED CHANNEL, COBBLE BOTTOM, AND VEGETATED RIGHT SIDE);

R_h = HYDRAULIC RADIUS = FLOW AREA / WETTED PERIMETER

FLOW AREA = $A_a \approx 405 FT^2$, PARTIAL WETTED PERIMETER FOR RIGHT SIDEWALL ≈ 15.9 FT, PARTIAL WETTED PERIMETER FOR LEFT SIDEWALL ≈ 7.0 FT, TOTAL WETTED PERIMETER ≈ 50FT + 15.9FT + 7.0FT ≈ 72.9 FT

$\Rightarrow R_h \approx 405 FT^2 / 72.9 FT \approx 5.6 FT$

$\therefore h_f \approx (100 FT) \times \left[(1.9 FPS)(0.05) / (1.49)(5.6 FT)^{2/3} \right]^2 \approx 0.04$

$\therefore$ TOTAL APPROACH CHANNEL LOSS ≈ 0.01 + 0.04 ≈ 0.05FT

$\Rightarrow$ ACTUAL EFFECTIVE HEAD ≈ 3.2 FT - 0.05FT ≈ 3.15FT

$\Rightarrow$ SPILLWAY CAPACITY ≈ $(3.33)(39 FT)(3.15 FT)^{3/2}$

≈ 730 CFS

(SUBMERGENCE EFFECTS ARE NEGLIGIBLE)

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SPILLWAY RATING CURVE

AS THE HEAD ABOVE THE WEIR BECOMES SMALL, THE ROUGHNESS OF THE CREST AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE CREST EXERT A LARGER INFLUENCE ON DISCHARGES. THAT IS, THE C-VALUES DECREASE WITH DECREASING HEAD. THE OPPOSITE TREND OCCURS FOR HIGHER HEADS. THEREFORE, ASSUME THAT THE DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR THE ACTUAL WEIR STRUCTURE CAN BE REPRESENTED BY THAT FOR AN OGEE-SHAPED WEIR (REF 4, PG 378, FIG 250). THE MAXIMUM HEAD PRIOR TO OVERTOPPING OF THE EMBANKMENT IS ABOUT 3.2 FT, WHICH WILL BE ASSUMED TO BE THE DESIGN HEAD (H_o). THE DESIGN DISCHARGE COEFFICIENT (C_o) WILL BE ASSUMED TO EQUAL 3.33 (SHEET 6).

ALL DISCHARGES OVER THE WEIR ARE DEFINED BY THE $Q = CLH^{3/2}$ RELATIONSHIP AS GIVEN ON SHEET 6. THE HEAD OVER THE WEIR WILL BE ADJUSTED TO ACCOUNT FOR APPROACH CHANNEL LOSSES BY PROPORTIONING THE COMPUTED LOSS OF 0.05 FT AT EL 1850.5 FT.

SPILLWAY RATING CURVE IS GIVEN ON SHEET 10.

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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RESERVOIR ELEVATION (FT)	① H (FT)	H/H_o (FT/FT)	② C/C_o	③ C	④ ESTIMATED APPROACH LOSS (FT)	⑤ EFFECTIVE HEAD: H_e (FT)	⑥ Q (CFS)
1947.3	0	–	–	–	–	0	0
1948.0	0.7	0.22	0.96	2.86	0.01	0.69	60
1849.0	1.7	0.53	0.93	3.10	0.03	1.67	260
1850.0	2.7	0.84	0.98	3.26	0.04	2.66	550
1850.5	3.2	1.0	1.0	3.33	0.05	3.15	730
1851.0	3.7	1.16	1.02	3.40	0.06	3.64	920
1852.0	4.7	1.47	1.06	3.53	0.07	4.63	1370
1853.0	5.7	1.78	1.07	3.56	0.09	5.61	1840
1854.0	6.7	2.09	1.08	3.60	0.10	6.60	2380
1855.0	7.7	2.41	1.09	3.63	0.12	7.58	2950
1856.0	8.7	2.72	1.10	3.66	0.14	8.56	3570

① H = RESERVOIR ELEVATION − 1947.3 FT ;
② REF 4, PG 378, FIG 250, BASED ON H/H_o ;
③ $C = C/C_o \times 3.33$;
④ ESTIMATED APPROACH LOSS $\approx (H/H_o) \times 0.05$ FT ;
⑤ $H_e \approx H$ − (ESTIMATED APPROACH LOSS) ;
⑥ $Q = C\,(39\,FT)\,H_e^{3/2}$

SUBJECT DAM SAFETY INSPECTION
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EMBANKMENT RATING CURVE

- LENGTH OF EMBANKMENT SUBMERGED VS RESERVOIR ELEVATION (BASED ON FIELD MEASUREMENTS)

RESERVOIR ELEVATION (FT)	EMBANKMENT LENGTH (FT)
1850.5	0
1850.6	150
1850.7	430
1850.9	540
1851.0	570
1851.2	600
1852.6	660
1853.0	670
1854.0	680
1855.0	700
1856.0	720

BASED PARTIALLY ON THE ABUTMENT SIDE SLOPES:
LEFT ABUTMENT ⇒ 12H TO 1V
RIGHT ABUTMENT ⇒ 5H TO 1V

- ASSUME THE EMBANKMENT ACTS LIKE A BROAD-CRESTED WEIR WHEN OVERTOPPED, W/ DISCHARGE DEFINED BY:

$$Q = CL\bar{H}^{3/2} \qquad \text{(SHEET 6)}$$

WHERE L = LENGTH OF EMBANKMENT INUNDATED, IN FT;
C = DISCHARGE COEFFICIENT FOR EMBANKMENTS
= $f(H/l$ WHERE l = BREADTH OF CREST ≈ 30FT, AND REF 12, PG 46); AND
$\bar{H}$ = AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE THE LOW TOP OF DAM EL 1850.5 FT. ASSUME THE LOW POINT OCCURS AT THE MIDDLE OF THE

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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EMBANKMENT, AND THAT THE INUNDATED EMBANKMENT LENGTH IS EVENLY DISTRIBUTED ON EITHER SIDE OF THE LOW POINT. SINCE THE EMBANKMENT PROFILE IS ROUGHLY TRIANGULAR IN SHAPE ⇒ AVERAGE HEAD ≈ ½ MAXIMUM HEAD.

RESERVOIR ELEVATION (FT)	① MAXIMUM HEAD H (FT)	② AVERAGE HEAD $\bar{H}$ (FT)	$\bar{H}/\ell$ (FT/FT)	③ C	④ L (FT)	⑤ Q (CFS)
1850.5	0	0	–	–	0	0
1850.6	0.1	0.05	0.0	2.90	150	0
1850.7	0.2	0.10	0.0	2.92	430	40
1850.9	0.4	0.20	0.01	2.97	540	140
1851.0	0.5	0.25	0.01	2.99	570	210
1851.2	0.7	0.35	0.01	3.01	600	370
1852.6	2.1	1.05	0.04	3.04	660	2160
1853.0	2.5	1.25	0.04	3.04	670	2850
1854.0	3.5	1.75	0.06	3.04	690	4790
1855.0	4.5	2.25	0.08	3.05	700	7210
1856.0	5.5	2.75	0.09	3.05	720	10010

① MAXIMUM HEAD = H = RESERVOIR ELEVATION - 1850.5 FT;
② AVERAGE HEAD = $\bar{H}$ = H/2;
③ REF 12, PG 46, BASED ON $\bar{H}/\ell$;
④ FROM SHEET 11;
⑤ $Q = C L \bar{H}^{3/2}$

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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TOTAL FACILITY RATING CURVE

TOTAL DISCHARGE = SPILLWAY Q + EMBANKMENT Q

	RESERVOIR ELEVATION (FT)	① SPILLWAY Q (CFS)	② EMBANKMENT Q (CFS)	TOTAL Q (CFS)
	1847.3	0	-	0
	1849.0	60	-	60
	1849.0	260	-	260
	1850.0	550	-	550
LOW TOP OF DAM	1850.5	730	0	730
	1850.6	* 770	0	770
	1850.7	* 810	40	850
	1850.9	* 880	140	1020
	1851.0	920	210	1130
	1851.2	* 1010	370	1380
	1852.0	1370	* 1390	2760
	1852.6	* 1650	2160	3810
	1853.0	1840	2950	4690
	1854.0	2390	4790	7170
	1855.0	2950	7210	10160
	1856.0	3570	10010	13580

① FROM SHEET 10
② FROM SHEET 12

* STRAIGHT-LINE INTERPOLATION

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00233
PENN DER ID # 56-91

SIZE OF DRAINAGE AREA: 3.8 square miles

ELEVATION TOP NORMAL POOL: 1847.3 STORAGE CAPACITY: 330 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 1850.5 STORAGE CAPACITY: 440 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1847.3 feet

TYPE: Concrete chute channel, with discharges controlled by a concrete weir structure.

CREST LENGTH: 39 feet

CHANNEL LENGTH: 60 feet

SPILLOVER LOCATION: right abutment

NUMBER AND TYPE OF GATES: none

OUTLET WORKS

TYPE: 18-inch diameter steel low level blowoff pipe encased in concrete; 16-inch diameter steel siphon pipe.

LOCATION: both located near left side of spillway.

ENTRANCE INVERTS: 1833 feet (blowoff; design)

EXIT INVERTS: 1822 feet (blowoff; field measurement)

EMERGENCY DRAWDOWN FACILITIES: Galvanized steel cable connected to embankment crest and to concrete lid covering blowoff inlet.

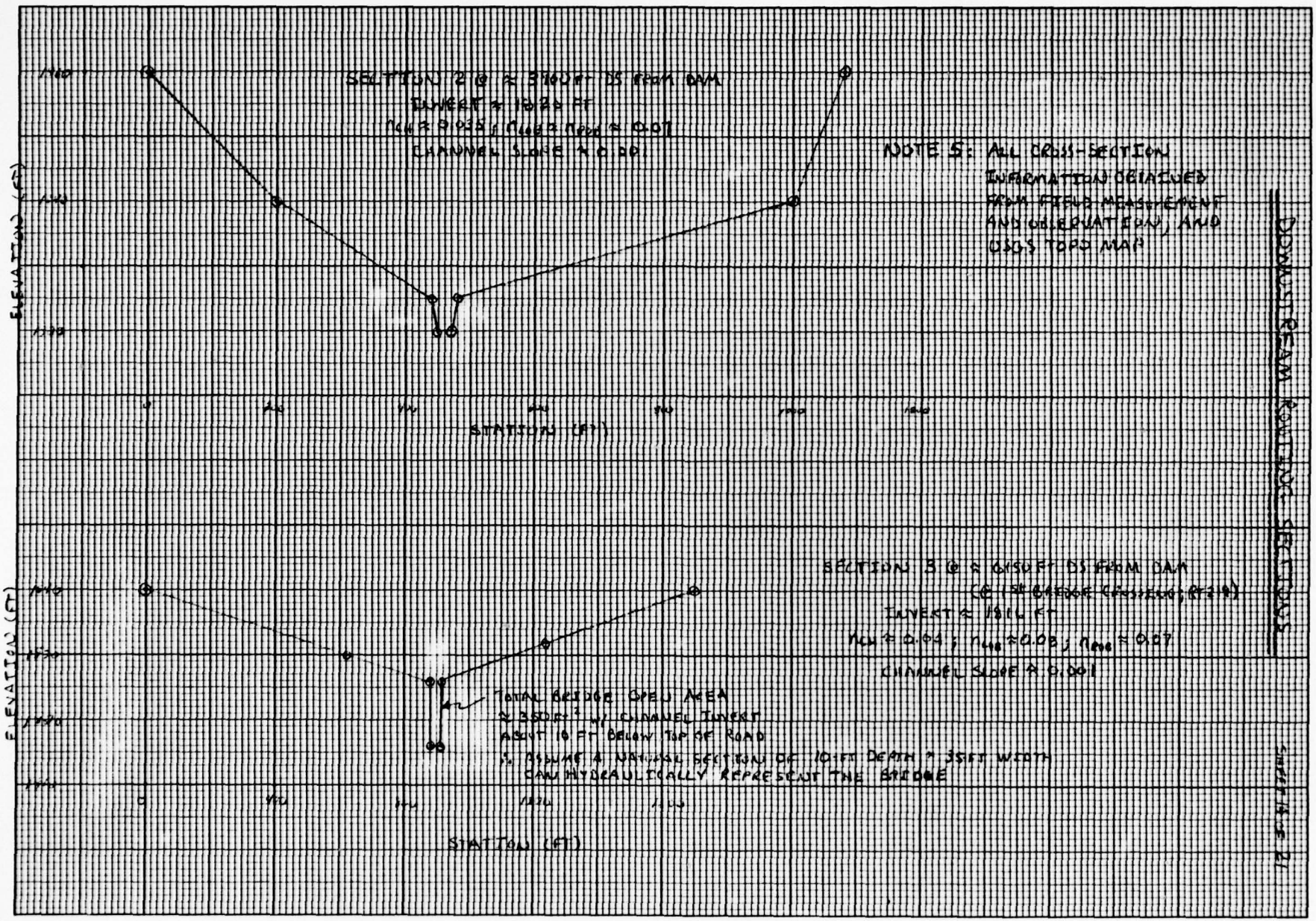
HYDROMETEOROLOGICAL GAGES

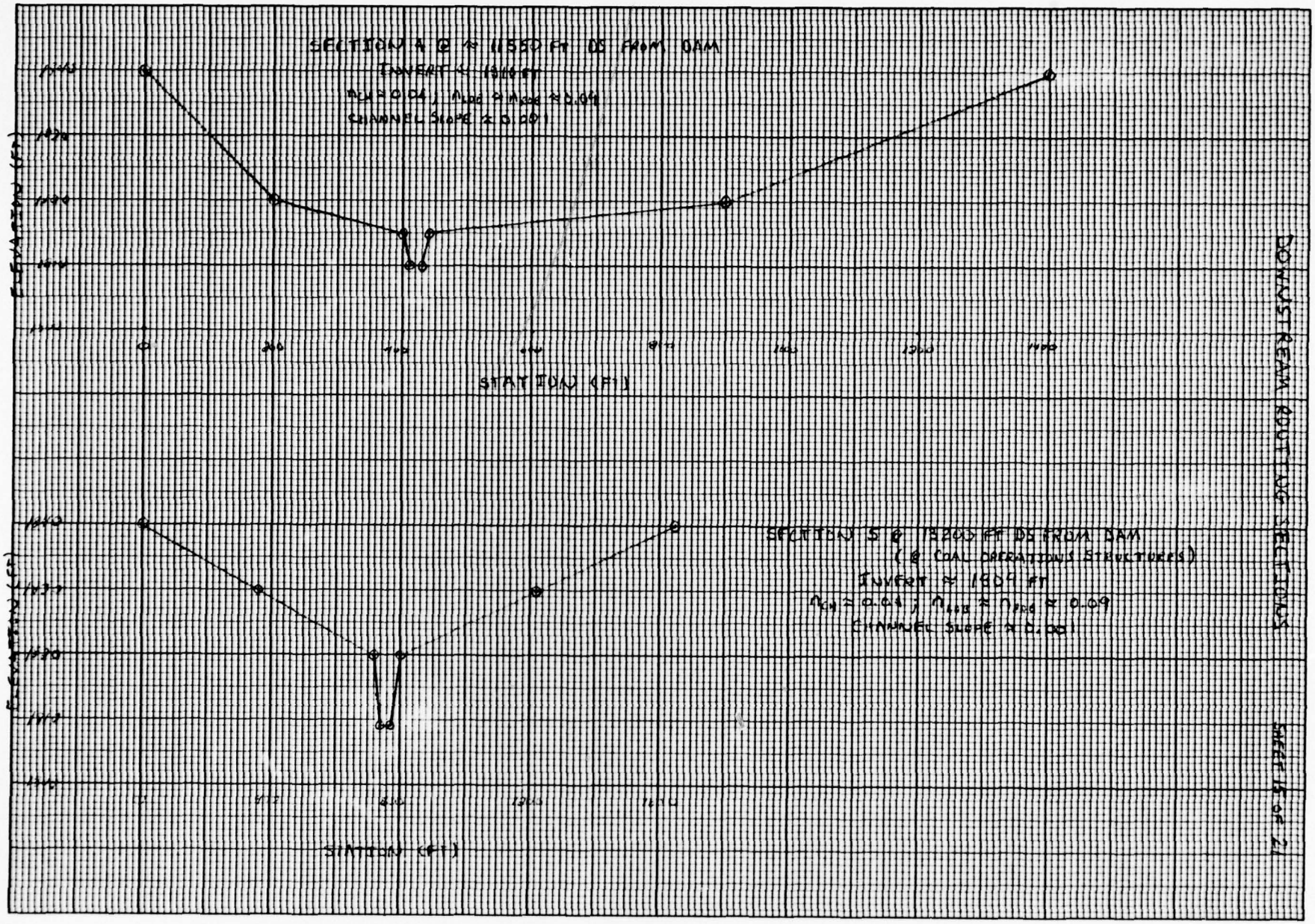
TYPE: None

LOCATION: N/A

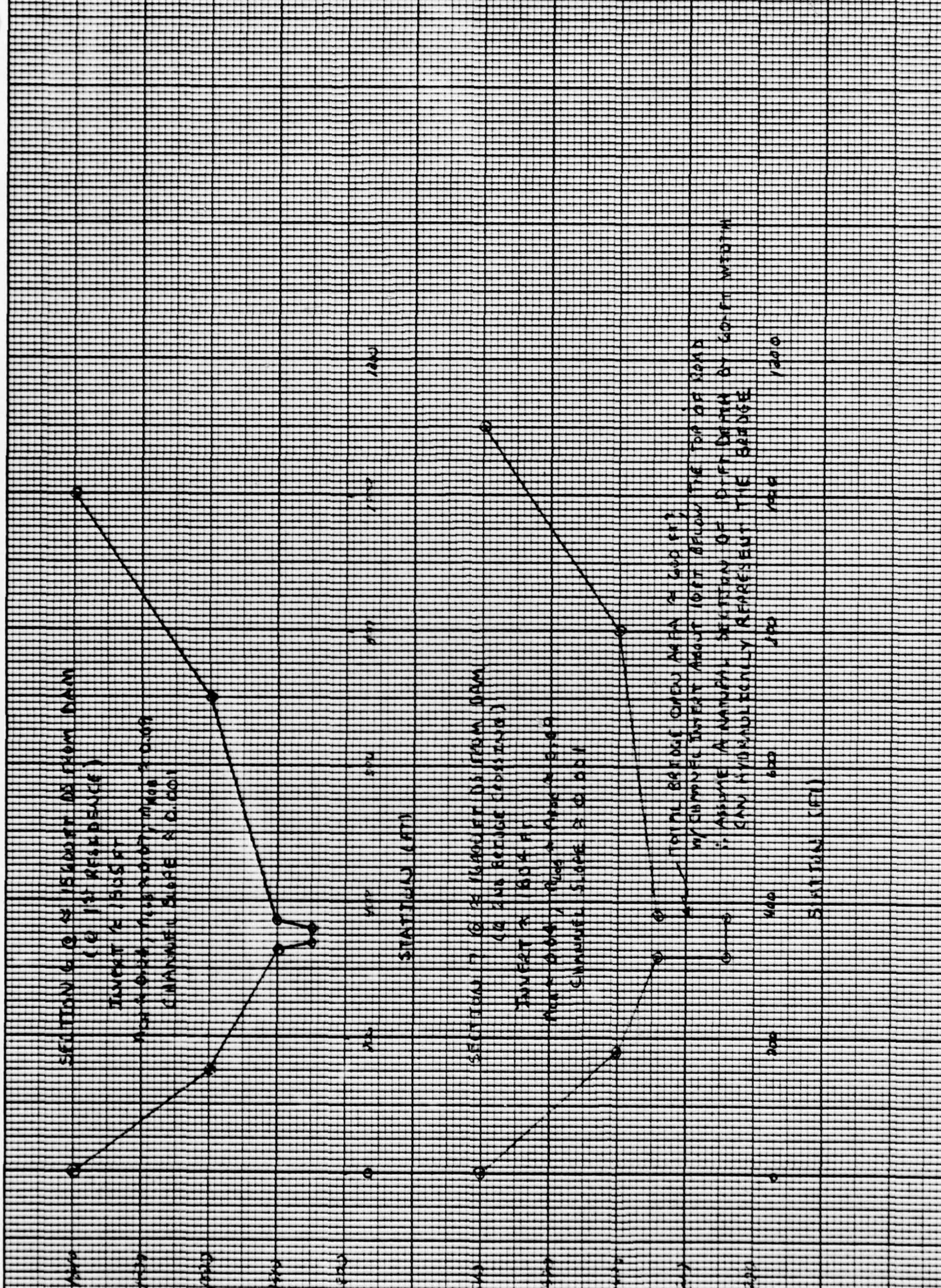
RECORDS: N/A

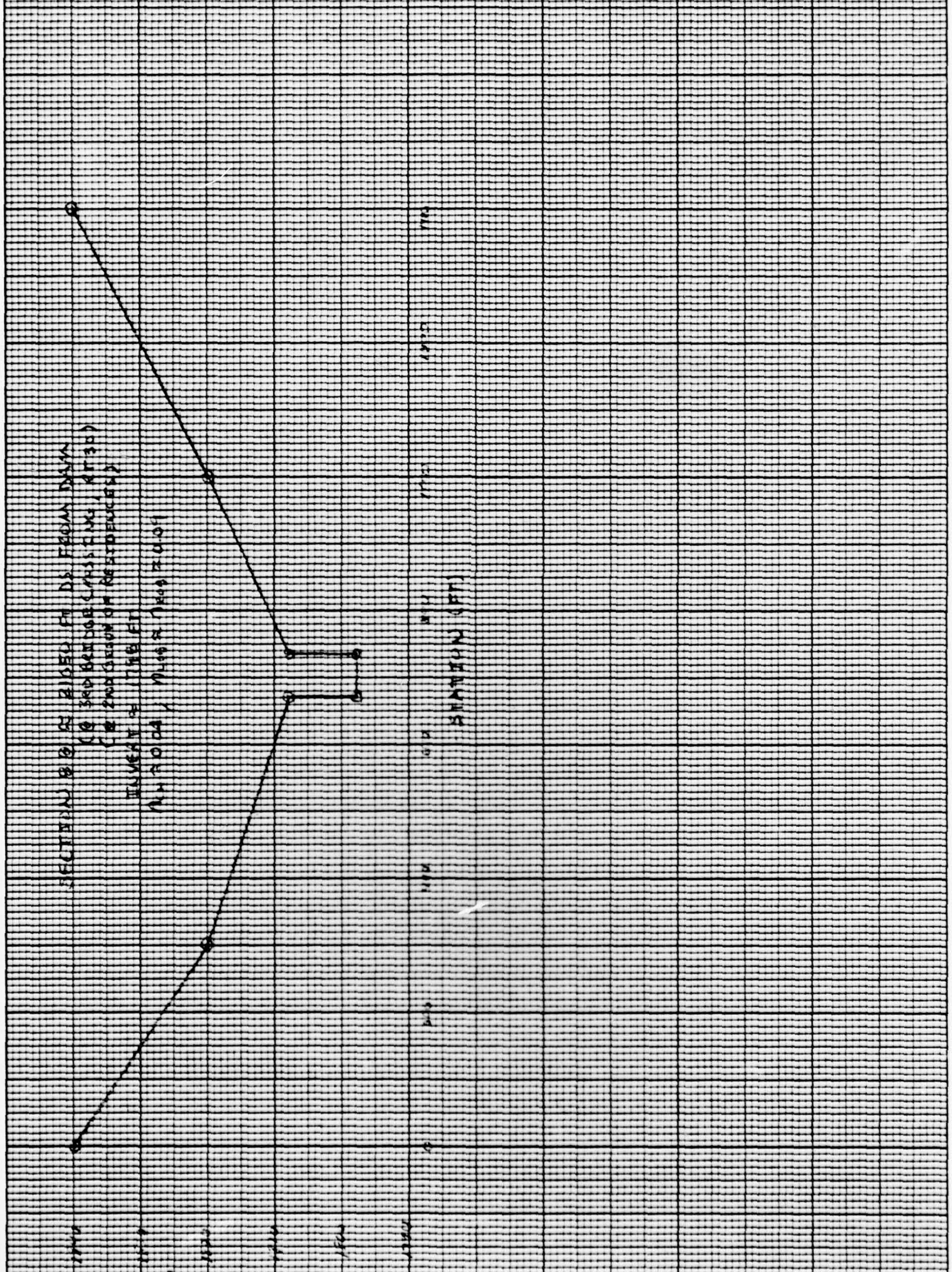
MAXIMUM NON-DAMAGING DISCHARGE: 14 inches to 16 inches over spillway weir crest (according to owner).


SECTION 2 @ ≈ 3160 FT DS FROM DAM
INVERT ≈ 1023 FT
n_{CH} ≈ 0.035 ; n_{LOB} = n_{ROB} ≈ 0.07
CHANNEL SLOPE ≈ 0.001
ELEVATION (FT)
STATION (FT)
NOTE 5: ALL CROSS-SECTION INFORMATION OBTAINED FROM FIELD MEASUREMENT AND INTERPOLATION, AND USGS TOPO MAP
SECTION 3 @ ≈ 6150 FT DS FROM DAM
(@ 1ST BRIDGE CROSSING; RT 19)
INVERT ≈ 1014 FT
n_{CH} ≈ 0.04 ; n_{LOB} ≈ 0.08 ; n_{ROB} ≈ 0.07
CHANNEL SLOPE ≈ 0.001
TOTAL BRIDGE OPEN AREA ≈ 350 FT² W/ CHANNEL INVERT ASSUT 10 FT BELOW TOP OF ROAD
5. ASSUME A RECTANGULAR SECTION OF 10 FT DEPTH × 35 FT WIDTH CAN HYDRAULICALLY REPRESENT THE BRIDGE
ELEVATION (FT)
STATION (FT)
DOWNSTREAM ROUTING SECTIONS
SHEET #3 OF 27


SECTION A @ ≈ 11550 FT DS FROM DAM
INVERT ≈ 1516 FT
n_{CH} = 0.04 ; n_{LOB} = n_{ROB} ≈ 0.09
CHANNEL SLOPE ≈ 0.001
STATION (FT)
SECTION S @ 15200 FT DS FROM DAM
(@ COAL OPERATIONS STRUCTURES)
INVERT ≈ 1504 FT
n_{CH} = 0.04 ; n_{LOB} = n_{ROB} ≈ 0.09
CHANNEL SLOPE ≈ 0.001
STATION (FT)
DOWNSTREAM ROUTING SECTIONS
SHEET 15 OF 21

DOWNSTREAM ROUTING SECTIONS




STATION (FT)
ELEVATION (FT)

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

BY WJV DATE 9-10-79 PROJ. NO. 78-617-233

CHKD. BY DLB DATE 9-12-79 SHEET NO. 18 OF 21

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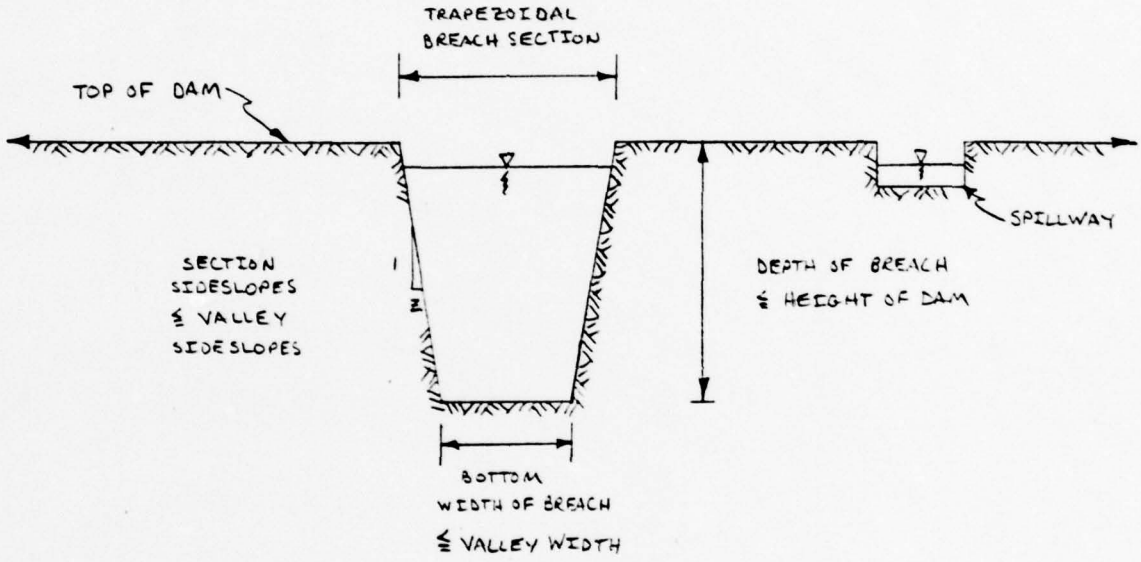
BREACH ASSUMPTIONS

- TYPICAL BREACH SECTION :



- HEC-1-DAM BREACHING ANALYSIS INPUTS :

(BREACHING WILL COMMENCE WHEN THE RESERVOIR LEVEL REACHES THE TOP OF DAM ELEVATION).

PLAN NUMBER AND COMMENT	BREACH BOTTOM WIDTH (FT)	MAX BREACH DEPTH (FT)	SECTION SIDESLOPES	* BREACH TIME (HR)	WSEL @ STA OF FAILURE (FT)
① MIN BREACH SECT, MIN FAIL TIME	0	29	½ H to 1 V	0.5	1850.5
② MAX BREACH SECT, MIN FAIL TIME	350	29	3 H to 1 V	0.5	1850.5
③ MIN BREACH SECT, MAX FAIL TIME	0	29	½ H to 1 V	4.0	1850.5
④ MAX BREACH SECT, MAX FAIL TIME	350	29	3 H to 1 V	4.0	1850.5
⑤ AVERAGE POSSIBLE CONDITIONS	100	29	1 H to 1 V	2.0	1850.5

SUBJECT DAM SAFETY INSPECTION
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- THE BREACH ASSUMPTIONS LISTED ON SHEET 18 ARE BASED SOMEWHAT ON INFORMATION CONCERNING EARTH DAM BREACHING PROVIDED BY THE COE, BALTIMORE DISTRICT; AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURRDUNDING TERRAIN:

CONSTRAINT	VALUE
HEIGHT OF DAM	≈ 29 FT (FIELD MEASURED)
EMBANKMENT CREST LENGTH:	
TO RIGHT OF SPWY	≈ 50 FT } FIELD MEASURED
TO LEFT OF SPWY	≈ 610 FT } FIELD MEASURED
TOTAL	≈ 660 FT } FIELD MEASURED
VALLEY BOTTOM WIDTH	≈ 350 FT (FIG 3)
VALLEY SIDESLOPES ADJACENT TO DAM:	
RIGHT WALL	3H TO 1V } FIG 3
LEFT WALL	7H TO 1V } FIG 3

SUBJECT DAM SAFETY INSPECTION

BY WJV DATE 9-10-79 PROJ. NO. 73-617-233

CHKD. BY DLB DATE 9-12-79 SHEET NO. 20 OF 21

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HEC-1-DAM BREACHING ANALYSIS OUTPUT :

RESERVOIR DATA

UNDER 0.15 PMF BASE FLOW CONDITIONS -

* PLAN NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	ACTUAL MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF FLOW (HR)	TIME OF INITIAL BREACH (HR)
①	0	5168	43.17	5168	43.17	5168	43.17	42.67
②	350	20085	42.90	17695	42.83	20095	42.90	42.67
③	0	2538	46.67	2538	46.67	2538	46.67	42.67
④	350	3662	43.50	3662	43.50	3662	43.50	42.67
⑤	100	5723	43.58	5647	43.67	5723	43.58	42.67

* SEE TABLE ON SHEET 18

SUBJECT DAM SAFETY INSPECTION

GALLO DAM

BY WJV DATE 9-10-79 PROJ. NO. 78-617-233

CHKD. BY DLB DATE 9-12-79 SHEET NO. 21 OF 21

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HEC-1- DAM BREACHING ANALYSIS OUTPUT :

DOWNSTREAM ROUTING DATA

UNDER 0.15 PMF BASE FLOW CONDITIONS :

PLAN [1.] NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	OUTPUT @ SECTION 6 LOCATED 15600 FT DS FROM DAM				OUTPUT @ SECTION 8 LOCATED 21050 FT DS FROM DAM			
		PEAK FLOW (CFS)	CORRESPONDING WSEL [2.] (FT)	WSEL [3.] W/O BREACH (FT)	ΔELEV [4.] (FT)	PEAK FLOW (CFS)	CORRESPONDING WSEL [2.] (FT)	WSEL [3.] W/O BREACH (FT)	ΔELEV [4.] (FT)
①	0	2279	1814.8	1811.5	+3.3	2250	1806.3	1802.1	+4.2
②	350	3076	1815.9	1811.5	+4.4	2985	1807.9	1802.1	+5.8
③	0	1901	1814.3	1811.5	+2.8	1863	1805.3	1802.1	+3.2
④	350	2448	1815.0	1811.5	+3.5	2423	1806.7	1802.1	+4.6
⑤	100	2943	1815.7	1811.5	+4.2	2870	1807.7	1802.1	+5.6

1. SEE TABLE ON SHEET 18 ;
2. WATER SURFACE ELEVATIONS CORRESPONDING TO BREACH OUTFLOWS (SUMMARY INPUT/OUTPUT SHEETS, SHEET P);
3. BASE FLOW ELEVATIONS CORRESPONDING TO THE PEAK 0.15 PMF AS INTERPOLATED FROM SHEET K, SUMMARY INPUT/OUTPUT SHEETS;
4. ΔELEV = (CORRESPONDING WSEL) − (WSEL W/O BREACH)

SUMMARY INPUT/OUTPUT SHEETS

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
BY WJY DATE 9-10-79 PROJ. NO. 78-617-233
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OVERTOPPING

DAM SAFETY INSPECTION
GALLO DAM ****** OVERTOPPING ANALYSIS ******
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1
RTIOS= .10 .20 .30 .40 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO GALLO DAM RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.80	0.00	3.80	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	140.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

INITIAL AND CONSTANT RAINFALL LOSS RATES AS PER COE

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.99 CP= .45 NTA= 0

BASEFLOW PARAMETERS AS PER COE

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=18.54 AND R=20.31 INTERVALS

SUBJECT DAM SAFETY INSPECTION

GALLO DAM

BY WJV DATE 9-10-79 PROJ. NO. 78-617-233

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UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 2.99 HOURS, CP= .45 VOL= .96

5.	17.	36.	58.	83.	110.	140.	171.	203.	236.
267.	295.	320.	341.	358.	371.	379.	383.	378.	367.
354.	342.	330.	318.	307.	296.	286.	276.	267.	257.
248.	240.	232.	223.	216.	208.	201.	194.	187.	181.
175.	168.	163.	157.	152.	146.	141.	136.	132.	127.
123.	118.	114.	110.	106.	103.	99.	96.	92.	89.
86.	83.	80.	77.	75.	72.	70.	67.	65.	63.
60.	58.	56.	54.	52.	51.	49.	47.	46.	44.
42.	41.	40.	38.	37.	36.	34.	33.	32.	31.
30.	29.	28.	27.	26.	25.	24.	23.	22.	22.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q
		SUM	26.88	24.46	2.42	283874.
			(683.)	(621.)	(61.)	(8038.42)

RESERVOIR INFLOW HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6099.	5017.	1910.	981.	282588.
CMS	173.	142.	54.	28.	8002.
INCHES		12.28	18.70	19.22	19.22
MM		311.98	474.94	488.08	488.08
AC-FT		2488.	3788.	3892.	3892.
THOUS CU M		3069.	4672.	4801.	4801.

0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	610.	502.	191.	98.	28259.
CMS	17.	14.	5.	3.	800.
INCHES		1.23	1.87	1.92	1.92
MM		31.20	47.49	48.81	48.81
AC-FT		249.	379.	389.	389.
THOUS CU M		307.	467.	480.	480.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1220.	1003.	382.	196.	56518.
CMS	35.	28.	11.	6.	1600.
INCHES		2.46	3.74	3.84	3.84
MM		62.40	94.99	97.62	97.62
AC-FT		498.	758.	778.	778.
THOUS CU M		614.	934.	960.	960.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3050.	2509.	955.	491.	141294.
CMS	86.	71.	27.	14.	4001.
INCHES		6.14	9.35	9.61	9.61
MM		155.99	237.47	244.04	244.04
AC-FT		1244.	1894.	1946.	1946.
THOUS CU M		1534.	2336.	2401.	2401.

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SUBJECT DAM SAFETY INSPECTION
GALLO DAM
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HYDROGRAPH ROUTING

ROUTE INFLOW THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1847.	-1

STAGE	1847.30	1848.00	1849.00	1850.00	1850.50	1850.60	1850.70	1850.90	1851.00
	1852.00	1852.60	1853.00	1854.00	1855.00	1856.00			
FLOW	0.00	60.00	260.00	550.00	730.00	770.00	850.00	1020.00	1130.00
	2760.00	3810.00	4690.00	7170.00	10160.00	13580.00			
SURFACE AREA=	0.	30.	33.	36.	47.	86.			
CAPACITY=	0.	260.	332.	443.	836.	2146.			
ELEVATION=	1819.	1845.	1847.	1851.	1860.	1880.			

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1847.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1850.5	0.0	0.0	0.

RESERVOIR OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 6073. AT TIME 42.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6073.	5005.	1845.	940.	270647.
CMS	172.	142.	52.	27.	7664.
INCHES		12.25	18.06	18.40	18.40
MM		311.20	458.82	467.46	467.46
AC-FT		2482.	3659.	3728.	3728.
THOUS CU M		3061.	4513.	4598.	4598.

PMF

PEAK OUTFLOW IS 533. AT TIME 44.17 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	533.	465.	160.	81.	23376.
CMS	15.	13.	5.	2.	662.
INCHES		1.14	1.56	1.59	1.59
MM		28.93	39.67	40.38	40.38
AC-FT		231.	316.	322.	322.
THOUS CU M		285.	390.	397.	397.

0.1 PMF

SUBJECT DAM SAFETY INSPECTION

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RESERVOIR OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 1192. AT TIME 43.17 HOURS — 0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1192.	962.	336.	171.	49235.
CMS	34.	27.	10.	5.	1394.
INCHES		2.36	3.29	3.35	3.35
MM		59.85	83.63	85.04	85.04
AC-FT		477.	667.	678.	678.
THOUS CU M		589.	823.	837.	837.

PEAK OUTFLOW IS 3025. AT TIME 42.83 HOURS — 0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3025.	2502.	899.	457.	131476.
CMS	86.	71.	25.	13.	3723.
INCHES		6.12	8.80	8.94	8.94
MM		155.57	223.49	227.08	227.08
AC-FT		1241.	1782.	1811.	1811.
THOUS CU M		1530.	2198.	2234.	2234.

HYDROGRAPH ROUTING

ROUTE FROM DAM TO SECTION 2 = 3900 FT DS FROM DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
102	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPAP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QR(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0700	.0350	.0700	1820.0	1860.0	3900.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1860.00 200.00 1840.00 440.00 1825.00 450.00 1820.00 470.00 1820.00
480.00 1825.00 1000.00 1840.00 1080.00 1860.00

STORAGE	0.00	4.56	10.71	22.07	52.23	102.49	172.86	263.33	373.91
	653.57	809.91	971.82	1139.27	1312.28	1490.85	1674.97	1864.65	2059.89
OUTFLOW	0.00	98.99	341.17	796.76	1667.40	3147.46	5408.45	8601.63	12865.59
	25602.55	34681.04	45029.41	56624.15	69451.10	83502.52	98775.26	115269.60	132988.43
STAGE	1820.00	1822.11	1824.21	1826.32	1828.42	1830.53	1832.63	1834.74	1836.84
	1841.05	1843.16	1845.26	1847.37	1849.47	1851.58	1853.68	1855.79	1857.89
FLOW	0.00	98.99	341.17	796.76	1667.40	3147.46	5408.45	8601.63	12865.59
	25602.55	34681.04	45029.41	56624.15	69451.10	83502.52	98775.26	115269.60	132988.43

HYDROGRAPH ROUTING

ROUTE FROM SECTION 2 TO SECTION 3 * 6150 FT DS FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
203	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVI	ELMAX	RLNTH	SEL
.0800	.0400	.0700	1816.0	1840.0	2250.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1840.00 620.00 1830.00 880.00 1826.00 880.00 1816.00 915.00 1816.00
915.00 1826.00 1240.00 1832.00 1700.00 1840.00

STORAGE	0.00	2.28	4.57	6.85	9.13	11.42	13.70	15.99	18.30
	44.15	71.80	109.18	156.14	212.89	279.49	355.94	442.23	538.38
OUTFLOW	0.00	58.09	176.59	333.23	517.95	724.47	948.48	1186.80	1440.77
	2400.49	3333.47	4704.31	6586.51	9055.56	12193.85	16071.14	20753.95	26306.05
STAGE	1816.00	1817.26	1818.53	1819.79	1821.05	1822.32	1823.58	1824.84	1826.11
	1828.63	1829.89	1831.16	1832.42	1833.68	1834.95	1836.21	1837.47	1838.74
FLOW	0.00	58.09	176.59	333.23	517.95	724.47	948.48	1186.80	1440.77
	2400.49	3333.47	4704.31	6586.51	9055.56	12193.85	16071.14	20753.95	26306.05

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
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GALLO DAM
BY WJV DATE 9-10-79 PROJ. NO. 78-617-233
CHKD. BY DLR DATE 9-12-79 SHEET NO. F OF P

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 3 TO SECTION 4 @ 11550 FT DS FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
304	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVI	ELMAX	RLNTH	SEL
.0900	.0400	.0900	1810.0	1840.0	5400.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1840.00 200.00 1820.00 400.00 1815.00 410.00 1810.00 430.00 1810.00
440.00 1815.00 900.00 1820.00 1400.00 1840.00

STORAGE	0.00	4.53	10.30	17.31	39.28	101.51	204.53	341.68	491.32
	823.04	1005.13	1198.03	1401.75	1616.29	1841.65	2077.82	2324.81	2582.62
OUTFLOW	0.00	52.64	177.20	371.12	722.88	1435.52	2702.17	4830.28	7737.48
	15553.21	20456.75	26032.66	32292.07	39248.20	46915.71	55310.16	64447.77	74345.17
STAGE	1810.00	1811.58	1813.16	1814.74	1816.32	1817.89	1819.47	1821.05	1822.63
	1825.79	1827.37	1828.95	1830.53	1832.11	1833.68	1835.26	1836.84	1838.42
FLOW	0.00	52.64	177.20	371.12	722.88	1435.52	2702.17	4830.28	7737.48
	15553.21	20456.75	26032.66	32292.07	39248.20	46915.71	55310.16	64447.77	74345.17

HYDROGRAPH ROUTING

ROUTE FROM SECTION 4 TO SECTION 5 @ 13200 FT DS FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
405	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNV1	ELMAX	RLNTH	SEL
.0900	.0400	.0900	1809.0	1840.0	1650.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1840.00 360.00 1830.00 720.00 1820.00 740.00 1809.00 770.00 1809.00
800.00 1820.00 1220.00 1830.00 1650.00 1840.00

STORAGE	0.00	2.08	4.62	7.62	11.08	15.00	19.37	24.45	35.36
	80.77	115.27	157.64	207.87	266.03	332.16	406.25	488.31	578.34
OUTFLOW	0.00	82.71	274.71	567.42	964.51	1472.18	2097.42	2892.49	4029.16
	7521.60	10085.58	13312.94	17282.57	22065.24	27741.76	34381.79	42052.31	50818.07
STAGE	1809.00	1810.63	1812.26	1813.89	1815.53	1817.16	1818.79	1820.42	1822.05
	1825.32	1826.95	1828.58	1830.21	1831.84	1833.47	1835.11	1836.74	1838.37
FLOW	0.00	82.71	274.71	567.42	964.51	1472.18	2097.42	2892.49	4029.16
	7521.60	10085.58	13312.94	17282.57	22065.24	27741.76	34381.79	42052.31	50818.07

HYDROGRAPH ROUTING

ROUTE FROM SECTION 5 TO SECTION 6 * 15600 FT DS FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
506	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNV1	ELMAX	RLNTH	SEL
.0700	.0400	.0900	1805.0	1840.0	2400.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1840.00 150.00 1820.00 330.00 1810.00 340.00 1805.00 360.00 1805.00
370.00 1810.00 700.00 1820.00 1000.00 1840.00

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
BY WJV DATE 9-10-79 PROJ. NO. 78-617-233
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STORAGE	0.00	2.40	5.56	9.81	21.37	42.45	73.07	113.23	162.92
	281.72	347.46	417.40	491.55	569.91	652.47	739.24	830.22	925.40
OUTFLOW	0.00	68.68	233.94	512.61	1020.44	1867.03	3161.96	4999.55	7465.35
	14985.79	19779.34	25257.26	31432.06	38318.56	45933.04	54292.72	63415.45	73319.46
STAGE	1805.00	1806.84	1808.68	1810.53	1812.37	1814.21	1816.05	1817.89	1819.74
	1823.42	1825.26	1827.11	1828.95	1830.79	1832.63	1834.47	1836.32	1838.16
FLOW	0.00	68.68	233.94	512.61	1020.44	1867.03	3161.96	4999.55	7465.35
	14985.79	19779.34	25257.26	31432.06	38318.56	45933.04	54292.72	63415.45	73319.46

HYDROGRAPH ROUTING

ROUTE FROM SECTION 6 TO SECTION 7 = 16400 FT DS FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
607	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVI	ELMAX	RLNTH	SEL
.0700	.0400	.0700	1804.0	1840.0	800.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1840.00 180.00 1820.00 320.00 1814.00 320.00 1804.00 380.00 1804.00
380.00 1814.00 800.00 1820.00 1100.00 1840.00

STORAGE	0.00	2.09	4.18	6.26	8.35	10.44	14.13	23.74	39.50
	83.96	108.79	135.20	163.19	192.76	223.92	256.66	290.98	326.88
OUTFLOW	0.00	196.85	601.36	1139.79	1778.59	2496.61	3399.06	4799.21	6987.73
	15011.82	20620.67	27209.91	34780.35	43341.30	52907.20	63495.83	75127.13	87822.54
STAGE	1804.00	1805.89	1807.79	1809.68	1811.58	1813.47	1815.37	1817.26	1819.16
	1822.95	1824.84	1826.74	1828.63	1830.53	1832.42	1834.32	1836.21	1838.11
FLOW	0.00	196.85	601.36	1139.79	1778.59	2496.61	3399.06	4799.21	6987.73
	15011.82	20620.67	27209.91	34780.35	43341.30	52907.20	63495.83	75127.13	87822.54

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
BY WJV DATE 9-10-79 PROJ. NO. 78-617-233
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HYDROGRAPH ROUTING

ROUTE FROM SECTION 7 TO SECTION 8 @ 21050 FT DS FROM DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
708	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QB(1)	QN(2)	QN(3)	ELMNT	ELMAX	RLNTH	SEL
.0900	.0400	.0900	1798.0	1840.0	4650.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1840.00 300.00 1820.00 670.00 1808.00 670.00 1798.00 735.00 1798.00
735.00 1808.00 1000.00 1820.00 1400.00 1840.00

STORAGE	0.00	15.34	30.68	46.01	61.35	79.82	122.10	191.99	289.48
	567.25	742.43	935.87	1147.56	1377.51	1625.71	1892.17	2176.89	2479.87
OUTFLOW	0.00	274.88	837.51	1583.57	2465.81	3521.39	4962.57	6963.75	9691.04
	17899.04	23852.57	30922.42	39157.16	48608.31	59328.64	71371.34	84789.48	99635.82
STAGE	1798.00	1800.21	1802.42	1804.63	1806.84	1809.05	1811.26	1813.47	1815.68
	1820.11	1822.32	1824.53	1826.74	1828.95	1831.16	1833.37	1835.58	1837.79
FLOW	0.00	274.88	837.51	1583.57	2465.81	3521.39	4962.57	6963.75	9691.04
	17899.04	23852.57	30922.42	39157.16	48608.31	59328.64	71371.34	84789.48	99635.82

SUBJECT DAM SAFETY INSPECTION

BY WJV DATE 9-10-79 PROJ. NO. 78-617-232

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GALLO DAM

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1847.30	1847.30	1850.50
STORAGE	332.	332.	443.
OUTFLOW	0.	0.	730.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1849.94	0.00	423.	533.	0.00	44.17	0.00
.20	1851.05	.55	463.	1192.	5.33	43.17	0.00
.30	1851.45	.95	478.	1815.	7.67	42.83	0.00
.40	1851.80	1.30	491.	2420.	8.33	42.83	0.00
.50	1852.15	1.65	504.	3025.	9.00	42.83	0.00
1.00	1853.56	3.06	558.	6073.	11.67	42.83	0.00

PLAN 1 STATION 102

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	530.	1825.1	44.50
.20	1167.	1827.2	43.67
.30	1784.	1828.6	43.33
.40	2383.	1829.4	43.33
.50	2979.	1830.3	43.33
1.00	5998.	1833.0	43.17

SECTION @ 3900 FT DS FROM DAM

PLAN 1 STATION 203

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	530.	1821.1	44.67
.20	1165.	1824.7	43.83
.30	1773.	1827.3	43.67
.40	2356.	1828.5	43.83
.50	2946.	1829.4	43.83
1.00	5948.	1832.0	43.50

SECTION @ 6150 FT DS FROM DAM (@ 1st BRIDGE CROSSING)

SUBJECT DAM SAFETY INSPECTION
GALLO DAM

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PLAN 1 STATION 304

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	515.	1815.4	45.33
.20	1079.	1817.1	44.83
.30	1656.	1818.2	44.67
.40	2218.	1818.9	44.83
.50	2786.	1819.5	44.67
1.00	5742.	1821.5	44.33

SECTION @ 11550 FT DS FROM DAM

PLAN 1 STATION 405

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	515.	1813.6	45.50
.20	1078.	1815.9	45.00
.30	1656.	1817.6	44.83
.40	2218.	1819.0	44.83
.50	2785.	1820.2	44.83
1.00	5731.	1823.8	44.50

SECTION @ 13200 FT DS FROM DAM (@ GAL OPERATIONS STRUCTURES)

PLAN 1 STATION 506

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	514.	1810.5	45.67
.20	1072.	1812.5	45.33
.30	1646.	1813.7	45.17
.40	2207.	1814.7	45.17
.50	2769.	1815.5	45.17
1.00	5705.	1818.4	44.67

SECTION @ 15600 FT DS FROM DAM (@ 1ST RESIDENCE)

PLAN 1 STATION 607

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	514.	1807.4	45.83
.20	1072.	1809.4	45.33
.30	1646.	1811.2	45.17
.40	2207.	1812.7	45.17
.50	2769.	1814.0	45.17
1.00	5702.	1818.0	44.83

SECTION @ 16400 FT DS FROM DAM (@ 2ND BRIDGE CROSSING

PLAN 1 STATION 708

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	511.	1801.1	46.17
.20	1068.	1803.1	45.67
.30	1641.	1804.8	45.33
.40	2201.	1806.2	45.33
.50	2761.	1807.5	45.33
1.00	5628.	1812.0	45.33

SECTION @ 21050 FT DS FROM DAM (@ 3RD BRIDGE CROSSING (@ 2ND GROUP OF RESIDENCES

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
BY WJV DATE 9-10-79 PROJ. NO. 78-617-237
CHKD. BY DLR DATE 9-12-79 SHEET NO. L OF P
BREACHING

BREACHING ANALYSIS CONSISTS OF SAME INPUT DATA AS FOR THE OVERTOPPING ANALYSIS W/ THE ADDITION OF THE BREACH DATA GIVEN HERE

DAM SAFETY INSPECTION
GALLO DAM ****** BREACHING ANALYSIS ******
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NDR	NRTIO	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 5 NRTIO= 1 LRTIO= 1

RTIOS= .15

HYDROGRAPH ROUTING

ROUTE INFLOW THROUGH RESERVOIR

PLAN

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1850.5	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	1821.50	.50	1847.30	1850.50

① STATION 101, PLAN 1, RATIO 1

BEGIN DAM FAILURE AT 42.67 HOURS

PEAK OUTFLOW IS 5160. AT TIME 43.17 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
350.	3.00	1821.50	.50	1847.30	1850.50

② STATION 101, PLAN 2, RATIO 1

BEGIN DAM FAILURE AT 42.67 HOURS

PEAK OUTFLOW IS 20085. AT TIME 42.90 HOURS

SUBJECT: DAM SAFETY INSPECTION
GALLO DAM

BY: WJV DATE: 9-10-79 PROJ. NO. 78-617-233

CHKD. BY: DLB DATE: 9-17-79 SHEET NO. M OF P

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PLAN

③

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	1821.50	4.00	1847.30	1850.50

STATION 101, PLAN 3, RATIO 1

BEGIN DAM FAILURE AT 42.67 HOURS

PEAK OUTFLOW IS 2538. AT TIME 46.67 HOURS

④

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
350.	3.00	1821.50	4.00	1847.30	1850.50

STATION 101, PLAN 4, RATIO 1

BEGIN DAM FAILURE AT 42.67 HOURS

PEAK OUTFLOW IS 3662. AT TIME 43.50 HOURS

⑤

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	1.00	1821.50	2.00	1847.30	1850.50

STATION 101, PLAN 5, RATIO 1

BEGIN DAM FAILURE AT 42.67 HOURS

PEAK OUTFLOW IS 5723. AT TIME 43.58 HOURS

SUBJECT DAM SAFETY INSPECTION
GALLO DAM
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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
42.667	0.000	737.		737.		0.	0.	0.
42.708	.042	1005.		895.		110.	110.	0.
42.750	.083	1273.		1157.		116.	225.	1.
42.792	.125	1540.		1470.		71.	296.	1.
42.833	.167	1808.		1808.		0.	296.	1.
42.875	.208	2146.		2155.		-10.	287.	1.
42.917	.250	2483.		2499.		-16.	271.	1.
42.958	.292	2821.		2831.		-10.	260.	1.
43.000	.333	3158.		3158.		-0.	260.	1.
43.042	.375	3432.		3464.		-32.	229.	1.
43.083	.417	3706.		3744.		-39.	190.	1.
43.125	.458	3979.		3999.		-19.	171.	1.
43.167	.500	4253.		4253.		0.	171.	1.
43.208	.542	4463.		4479.		-16.	154.	1.
43.250	.583	4672.		4682.		-10.	145.	0.
43.292	.625	4882.		4895.		-12.	132.	0.
43.333	.667	5092.		5092.		0.	132.	0.
43.375	.708	5230.		5278.		-48.	84.	0.
43.417	.750	5368.		5431.		-63.	21.	0.
43.458	.792	5506.		5552.		-46.	-25.	-0.
43.500	.833	5644.		5644.		0.	-25.	-0.
43.542	.875	5645.		5703.		-59.	-84.	-0.
43.583	.917	5645.		5723.		-77.	-161.	-1.
43.625	.958	5646.		5704.		-57.	-219.	-1.
43.667	1.000	5647.		5647.		0.	-219.	-1.
43.708	1.042	5510.		5556.		-46.	-265.	-1.
43.750	1.083	5372.		5432.		-60.	-325.	-1.
43.792	1.125	5234.		5278.		-44.	-369.	-1.
43.833	1.167	5096.		5096.		0.	-369.	-1.
43.875	1.208	4863.		4890.		-28.	-397.	-1.
43.917	1.250	4629.		4664.		-35.	-431.	-1.
43.958	1.292	4396.		4420.		-24.	-456.	-2.
44.000	1.333	4162.		4162.		0.	-456.	-2.
44.042	1.375	3889.		3894.		-5.	-461.	-2.
44.083	1.417	3616.		3620.		-5.	-466.	-2.
44.125	1.458	3343.		3344.		-2.	-467.	-2.
44.167	1.500	3069.		3069.		0.	-467.	-2.
44.208	1.542	2817.		2800.		17.	-450.	-2.
44.250	1.583	2564.		2539.		25.	-426.	-1.
44.292	1.625	2312.		2291.		20.	-406.	-1.
44.333	1.667	2059.		2059.		0.	-406.	-1.
44.375	1.708	1876.		1845.		31.	-375.	-1.
44.417	1.750	1692.		1650.		42.	-332.	-1.
44.458	1.792	1509.		1477.		32.	-300.	-1.
44.500	1.833	1326.		1326.		0.	-300.	-1.
44.542	1.875	1224.		1196.		28.	-272.	-1.
44.583	1.917	1122.		1086.		36.	-236.	-1.
44.625	1.958	1020.		994.		26.	-210.	-1.
44.667	2.000	918.		918.		0.	-210.	-1.

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SUBJECT DAM SAFETY INSPECTION
GALLO DAM

BY WJV DATE 9-10-79 PROJ. NO. 78-617-233

CHKD. BY DLB DATE 9-12-79 SHEET NO. O OF P

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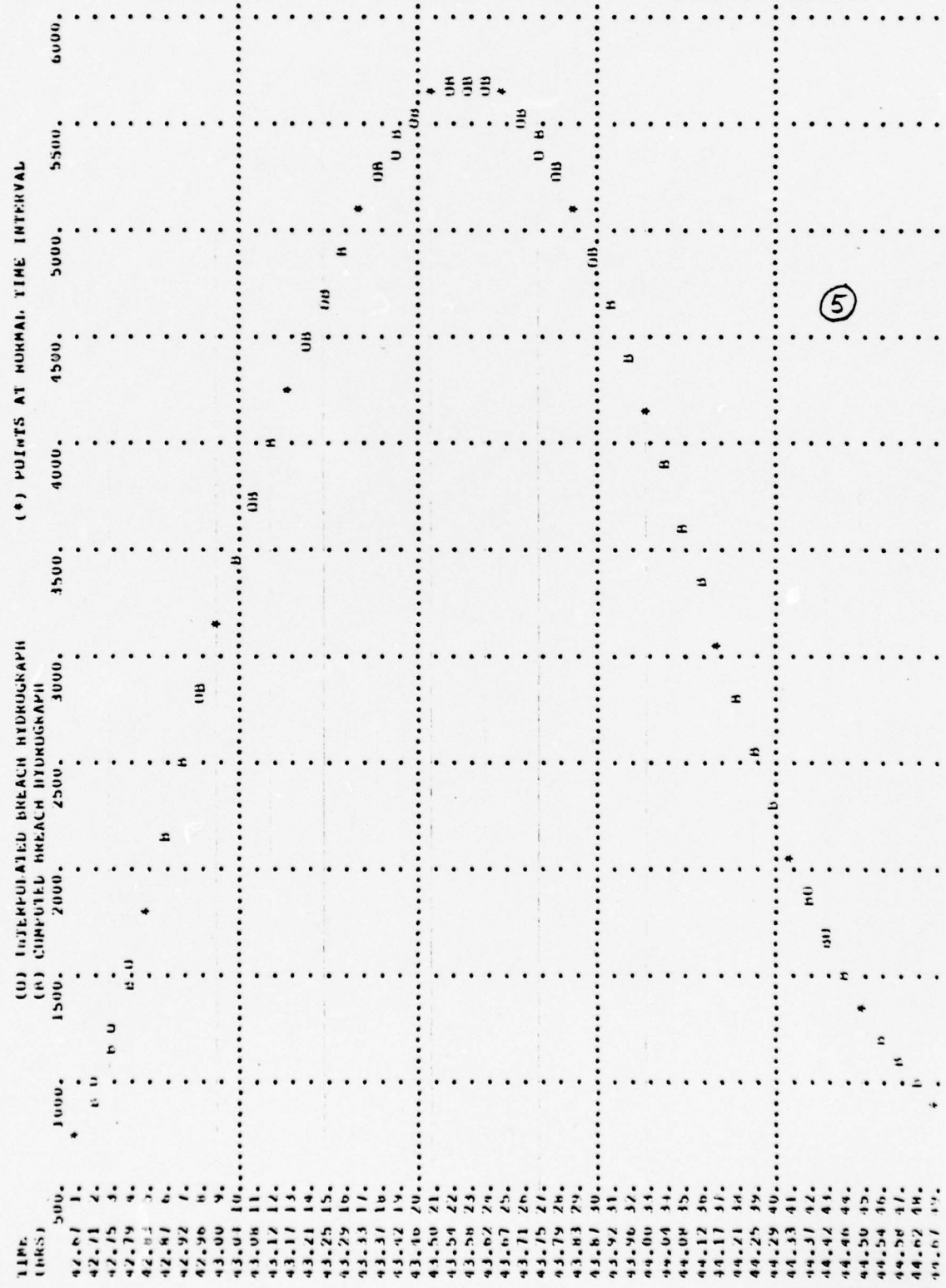


SUBJECT DAM SAFETY INSPECTION

GALLO DAM

BY WJV DATE 9-10-79 PROJ. NO. 78-617-232

CHKD. BY DLB DATE 9-12-79 SHEET NO. P OF P

CONSULTANTS, INC.

Engineers • Geologists • Planners
Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1847.30	1847.30	1850.50
STORAGE	332.	332.	443.
OUTFLOW	0.	0.	730.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
①	.15	1850.55	.05	445.	5168.	.38	43.17	42.67
②	.15	1850.52	.02	443.	20085.	.18	42.90	42.67
③	.15	1850.66	.16	449.	2538.	1.42	46.67	42.67
④	.15	1850.52	.02	443.	3662.	.25	43.50	42.67
⑤	.15	1850.53	.03	444.	5723.	.25	43.58	42.67

STATION 506

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
①	.15	2279.	1814.8	45.33
②	.15	3076.	1815.9	44.33
③	.15	1901.	1814.3	48.00
④	.15	2448.	1815.0	45.50
⑤	.15	2943.	1815.7	45.17

SECTION @ 15600 FT DS FROM DAM (@ 1ST RESIDENCE)

STATION 708

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
①	.15	2250.	1806.3	45.67
②	.15	2985.	1807.9	44.67
③	.15	1863.	1805.3	48.00
④	.15	2423.	1806.7	45.83
⑤	.15	2870.	1807.7	45.50

SECTION @ 21050 FT DS FROM DAM (@ 2ND GROUP OF RESIDENCES)

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 — View of reservoir and surrounding hillsides as seen from the spillway channel.

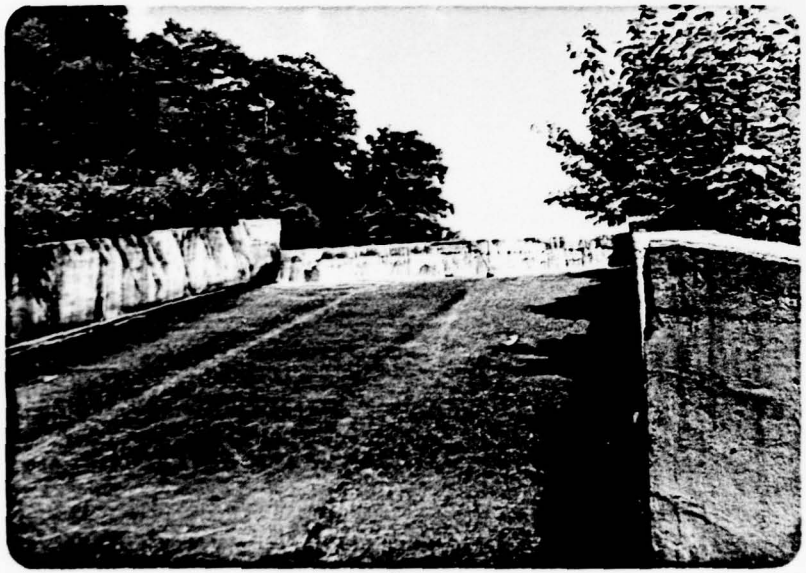
PHOTOGRAPH 2 — View of the downstream face of the dam. Note the siphon line and gate valve in the right center portion of the photo, and the lush vegetation on the D/S slopes.

PHOTOGRAPH 3 — View of the spillway from near the plunge pool. Note concrete caps that were added to the weir crest and left sidewall (also to the right sidewall). Also note the cracking of the weir, and the apparent rotation of the weir cap.

PHOTOGRAPH 4 — View of the downstream area as seen from the spillway crest. Note that a portion of the downstream terminus of the spillway has spalled off. Some minor cracking and efflorescence is visible on the spillway sidewalls.

1

2



3

4

PHOTOGRAPH 5 View of an erosion ditch at the downstream edge of the dam crest.

PHOTOGRAPH 6 View of a spring downstream of the dam at the left abutment.

PHOTOGRAPH 7 View of a small spring that flows along the downstream toe of the dam.

PHOTOGRAPH 8 View of the toe of the dam near the discharge end of the low level outlet. Note the heavy vegetation on the downstream face of the dam.

5

6

7

8

APPENDIX E

GEOLOGY

GEOLOGY

Gallo Dam is located in the Allegheny Mountain Section of the Appalachian Plateaus Physiographic Province. The Allegheny Mountain Section is characterized by gently folded sedimentary rock strata of Pennsylvanian age or older. Major structural axes strike from southwest to northeast of flanking strata dipping northwest and southeast.

Gallo Dam and reservoir are located just southwest of Jennerstown at the base of the east flank of Laurel Hill. Structurally the dam lies just west of the axial trace of the Johnstown syncline. Bedrock beneath the dam, therefore, gently tips to the southeast at approximately 1 to 2 degrees.

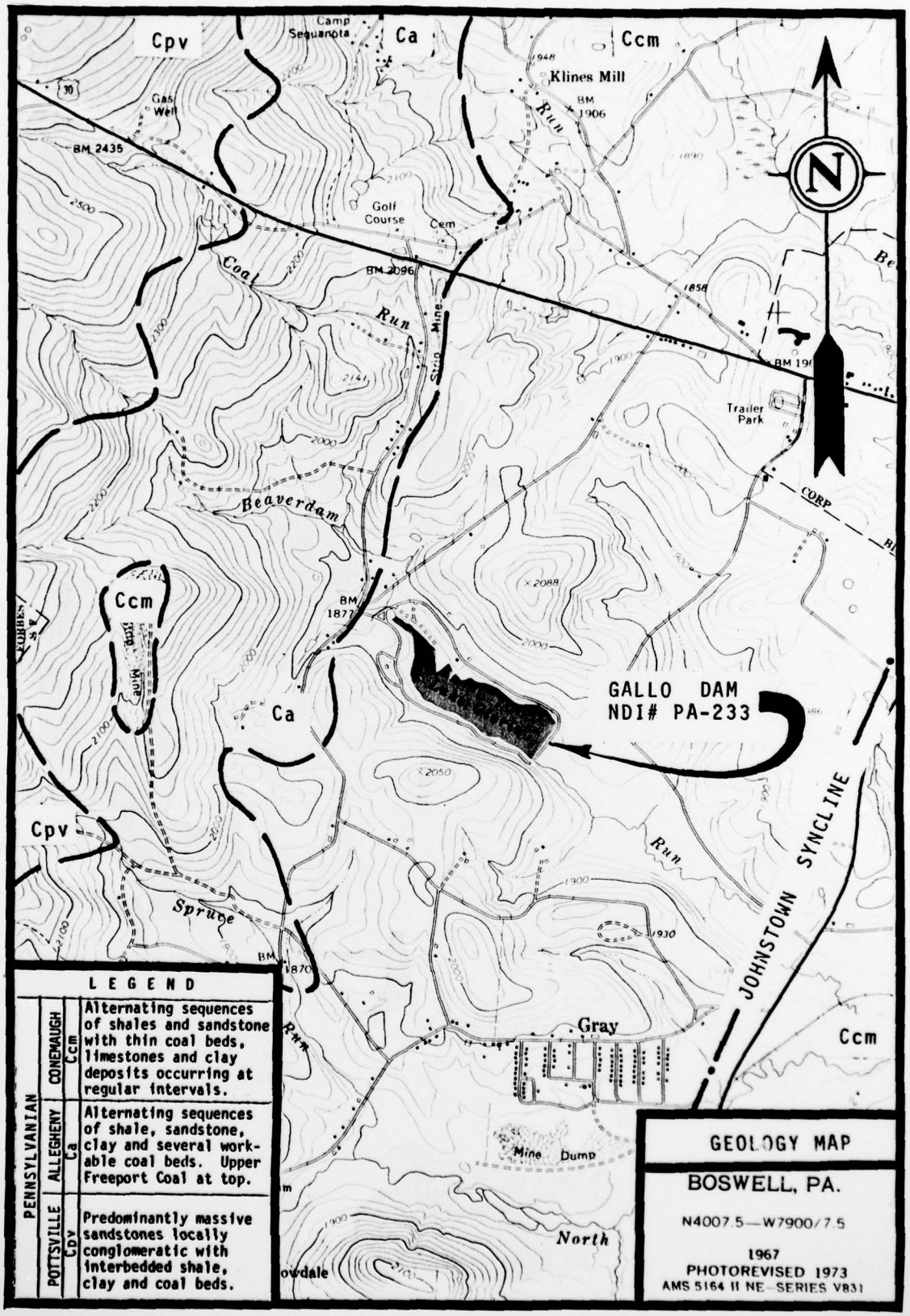
The dam and reservoir are located on sedimentary rock strata of the Conemaugh Group of Pennsylvanian age. The embankment is constructed on bedrock of the middle members of the Conemough Group. This section typically consists of interbedded shales and sillstones some sandstone, and a few thin limestones and minor coal beds.

Flint, N.K., "Geology and Mineral Resources of Southern Somerset County, Pennsylvania", Pennsylvania Geological Survey, C56A, Harrisburg, Pennsylvania 1965.

.40	2201.	45.33
.50	2761.	45.33
1.00	5628.	

1807.5
1812.0

(@ 2ND GROUP OF REJOINTS



APPENDIX F

FIGURES

PLAN ③ ④ ⑤

LIST OF FIGURES

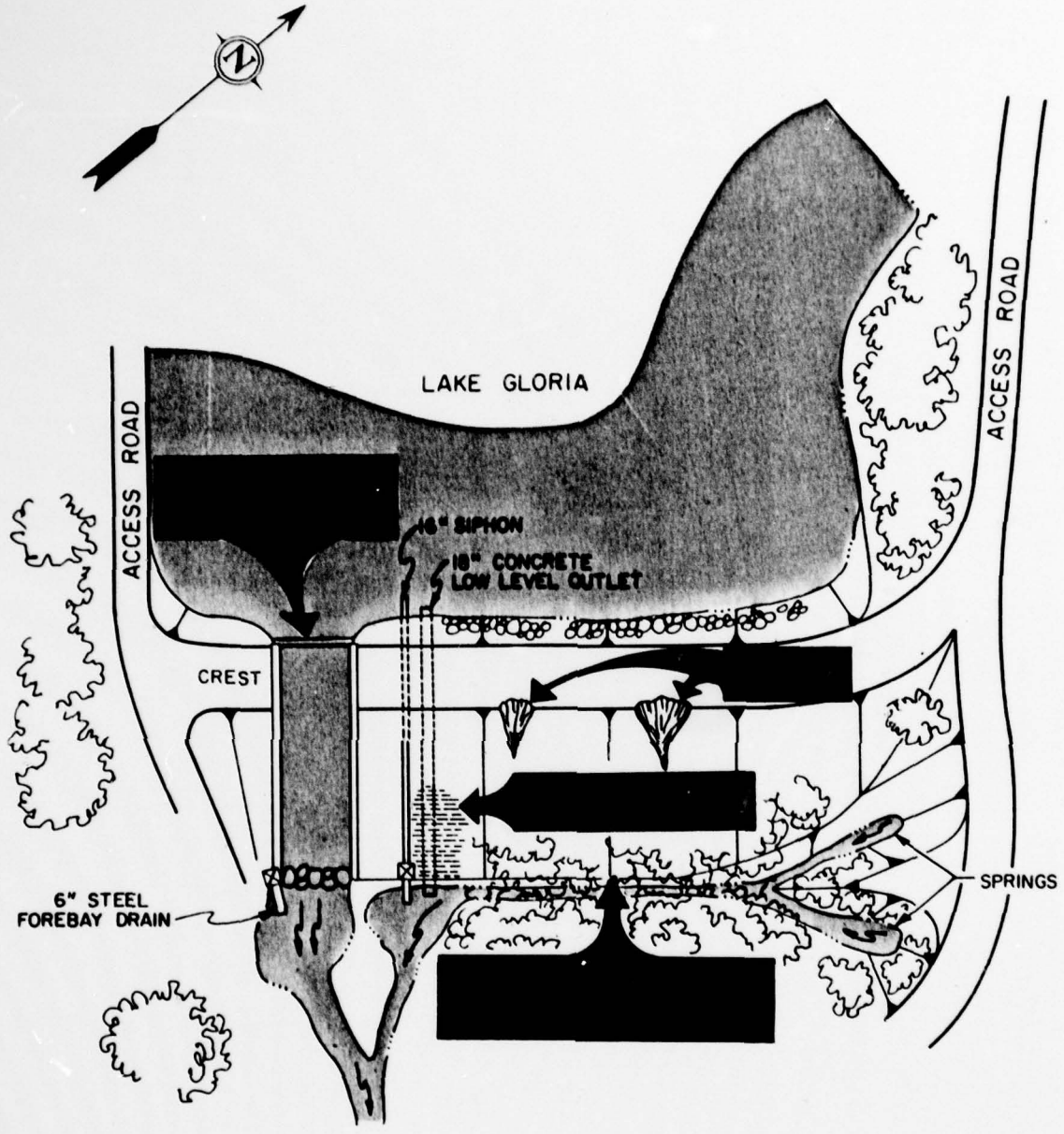
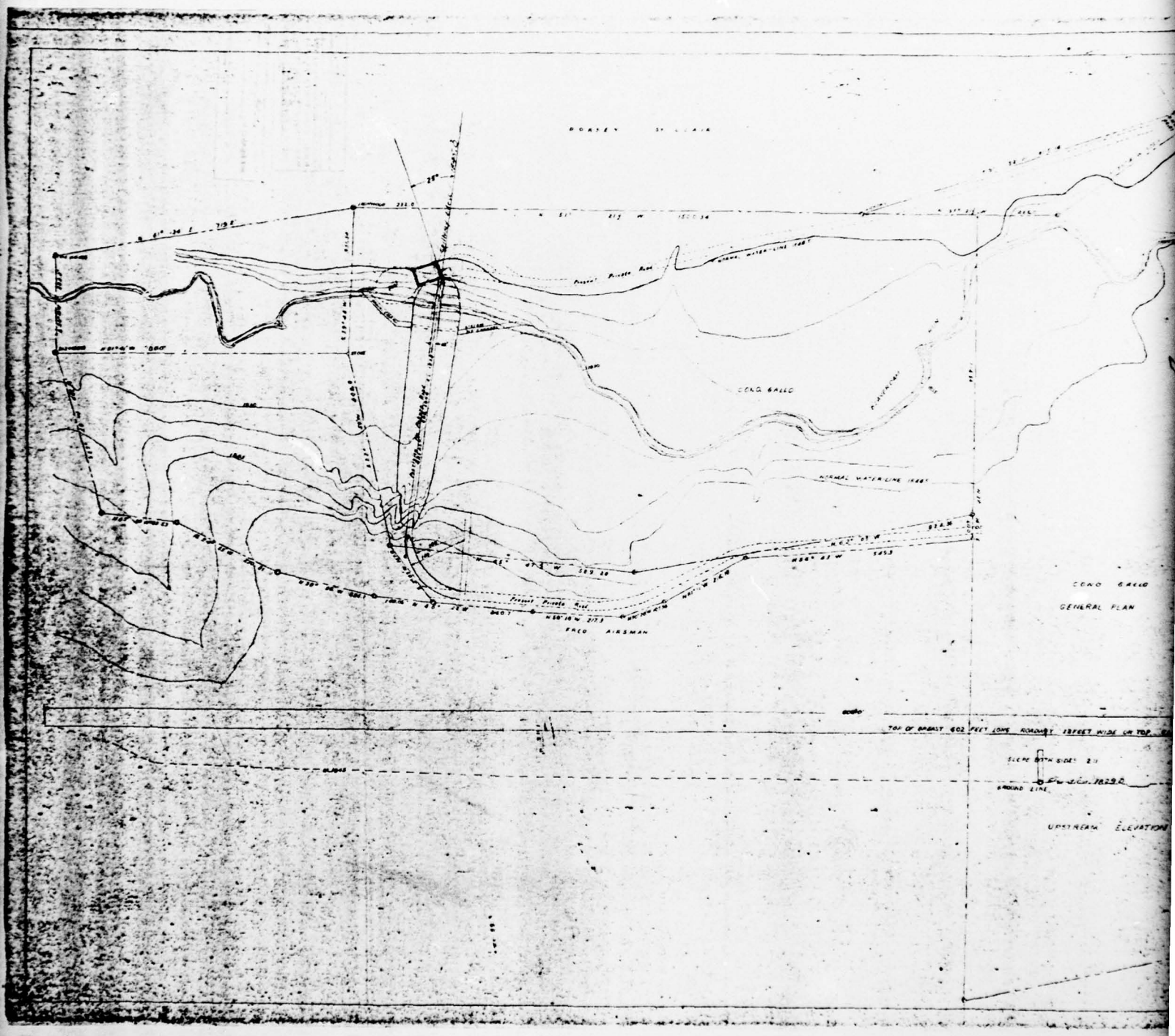


FIGURE 1 - GALLO DAM
GENERAL PLAN
FIELD INSPECTION NOTES


CONO GALLO
GENERAL PLAN
TOP OF BARRIER 602 FEET LONG ROADWAY 18FEET WIDE ON TOP
SLOPE BOTH SIDES 2:1
GROUND LINE
UPSTREAM ELEVATION
FRED AIRSMAN

1.

2.

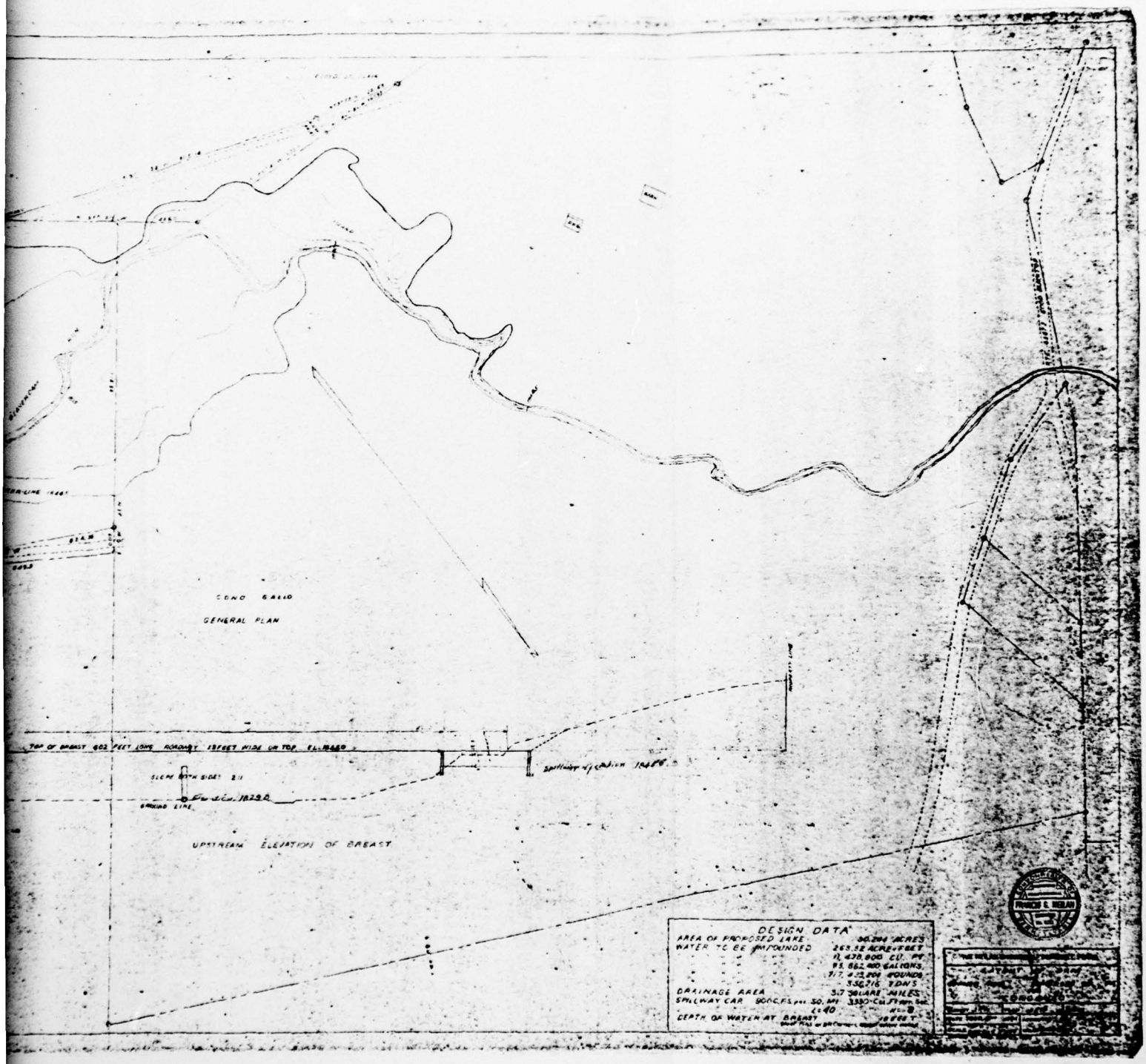
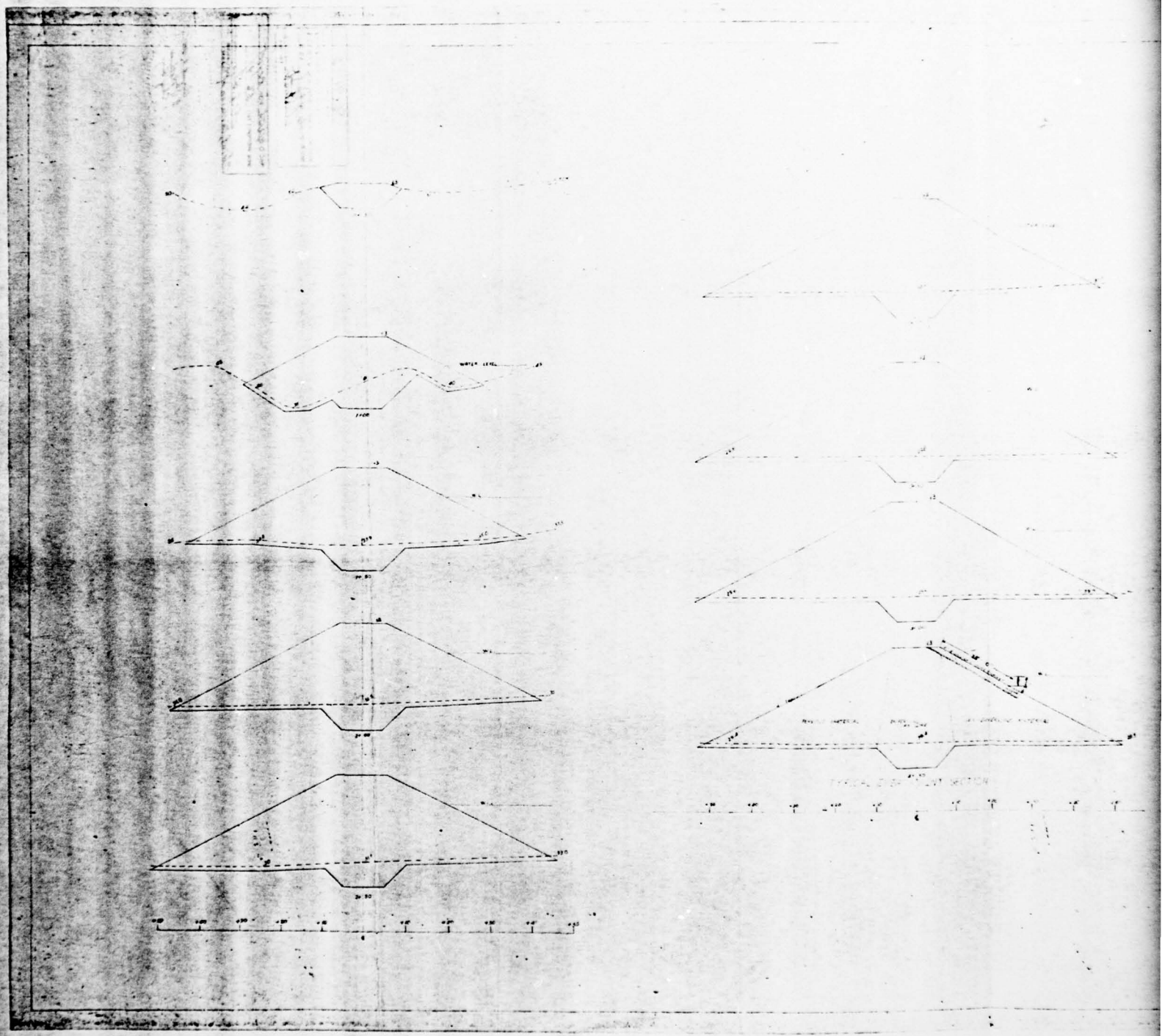

CONO GALLO
GENERAL PLAN
UPSTREAM ELEVATION OF BREAST
DESIGN DATA
AREA OF PROPOSED LAKE 96.294 ACRES
WATER TO BE IMPOUNDED 263.52 ACRE-FEET
11,478,800 CU. FT.
85,862,400 GALLONS,
917,412,864 POUNDS,
458,706 TONS
DRAINAGE AREA 3.7 SQUARE MILES
SPILLWAY CAP. 900 C.F.S. per SQ. MI.
DEPTH OF WATER AT BREAST

FIGURE 2

2.

3.



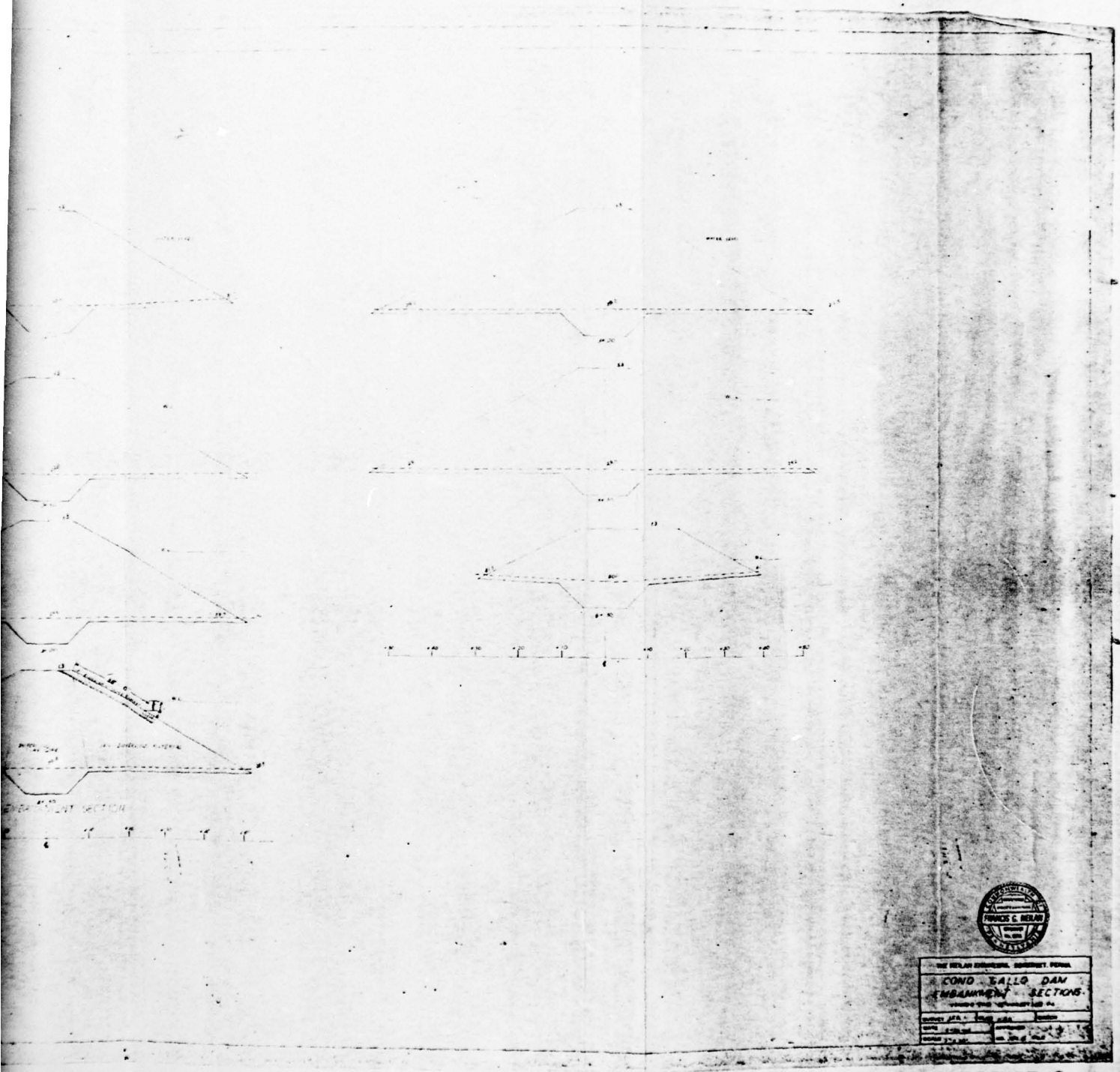
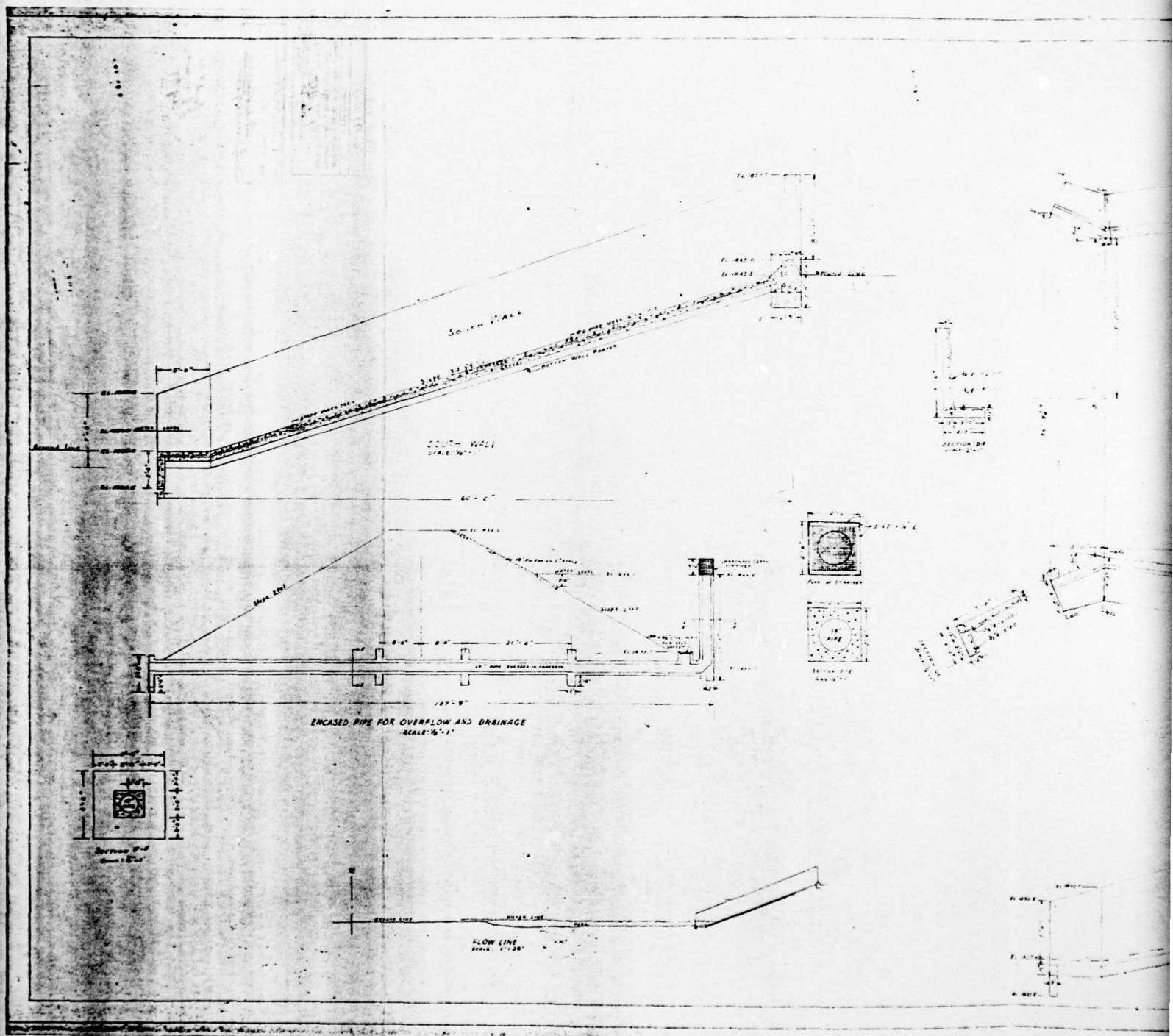


FIGURE 3


SOUTH WALL
SOUTH WALL
EMCASED PIPE FOR OVERFLOW AND DRAINAGE
FLOW LINE

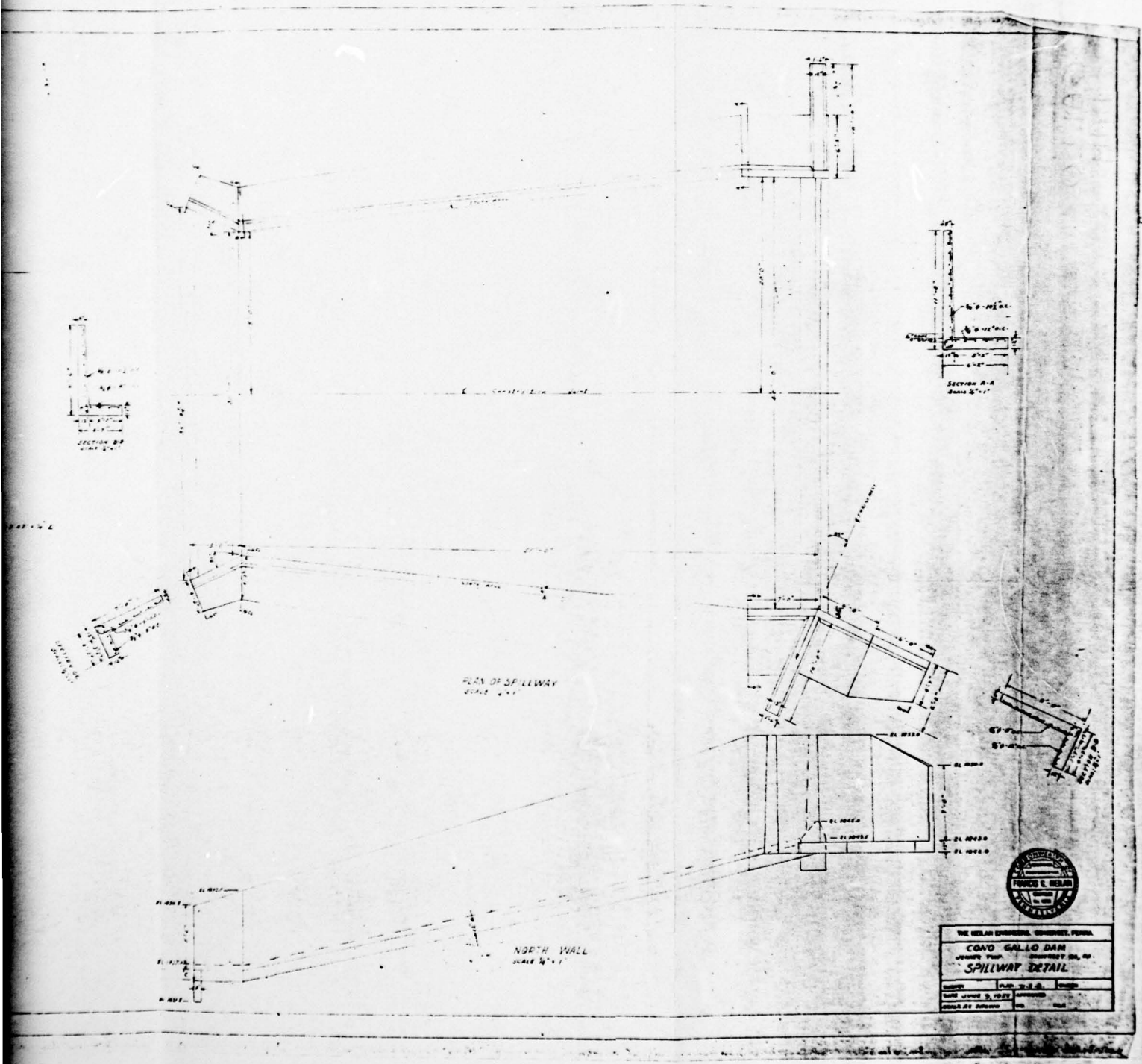
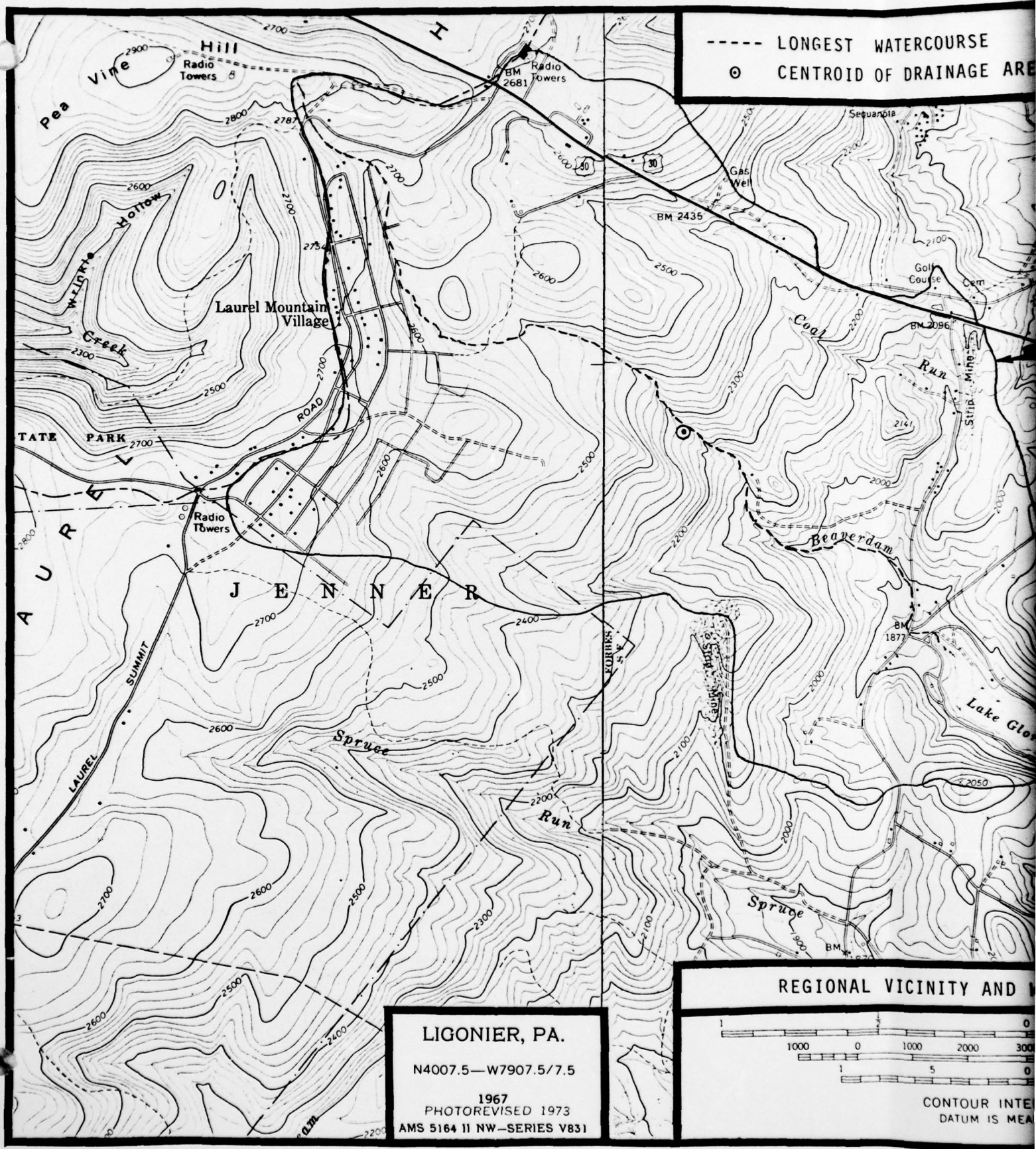
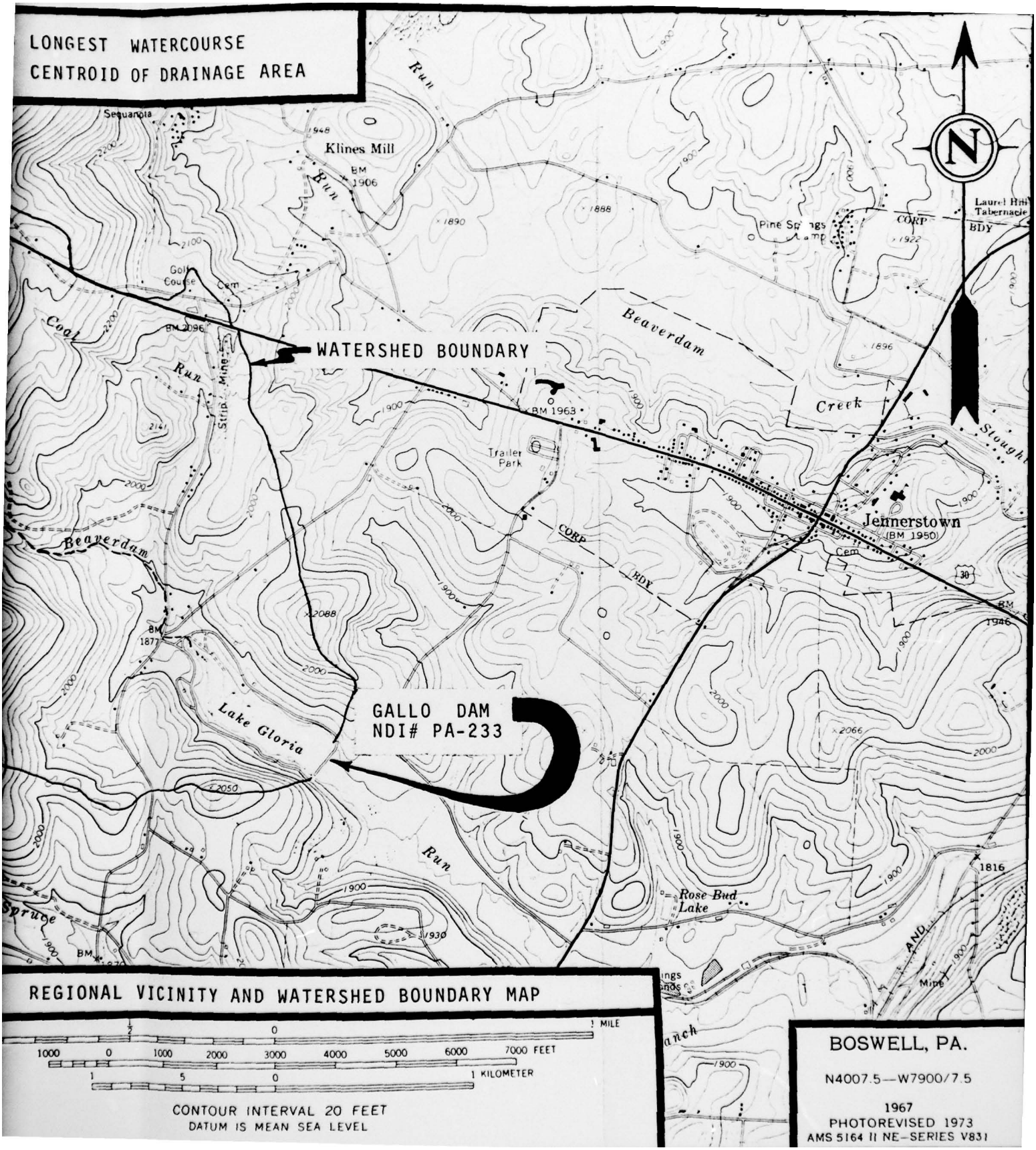


FIGURE 4

APPENDIX G

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP


----- LONGEST WATERCOURSE
⊙ CENTROID OF DRAINAGE ARE
Pea Vine Hill
Radio Towers
BM 2681
Radio Towers
Sequanota
Gas Well
BM 2435
Golf Course
Cem
BM 2096
Coal Run
Strip Mine
Laurel Mountain Village
White Hollow
Creek
ROAD
TATE PARK
Radio Towers
L A U R E L
J E N N E R
SUMMIT
LAUREL
Beaverdam
Run
BM 1877
Lake Glo
FORBES S.F.
Spruce
Run
Spruce
BM
REGIONAL VICINITY AND
CONTOUR INTE
DATUM IS MEA
LIGONIER, PA.
N4007.5—W7907.5/7.5
1967
PHOTOREVISED 1973
AMS 5164 II NW—SERIES V831


LONGEST WATERCOURSE
CENTROID OF DRAINAGE AREA
WATERSHED BOUNDARY
GALLO DAM
NDI# PA-233
Sequanota
Klines Mill
BM 1906
Run
Golf Course
Cem
Cool Run
BM 2096
Strip Mine
Beaverdam Run
Beaverdam Creek
BM 1963
Trailer Park
CORP BDY
Pine Springs Camp
Laurel Hill Tabernacle
Jennerstown
(BM 1950)
Cem
30
BM 1946
BM 1877
Lake Gloria
Spruce Run
Rose Bud Lake
1816
Mine
N
REGIONAL VICINITY AND WATERSHED BOUNDARY MAP
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
BOSWELL, PA.
N4007.5—W7900/7.5
1967
PHOTOREVISED 1973
AMS 5164 II NE-SERIES V831